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ABSTRACT

Designed for grades K-3, this guide contains 16 interdisciplinary lessons on energy which were developed to assist Arkansas teachers in incorporating energy education into existing curricula. Program objectives are listed under four broad categories: (1) energy sources, alternatives, and conversion; (2) energy uses; (3) conservation; and (4) limits and impacts. Each lesson follows a uniform format which includes category of objectives, title, related subject areas, energy types, grade level, time, materials, learning objectives, task analysis (prerequisite knowledge and skills), and procedure (preparation, steps in lesson, evaluation and follow-up activities). A section on teacher background information and student worksheets follow each lesson. A glossary, list of selected references, and program evaluation forms are provided. (DC)

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# S.A.V.E.

## STUDYING ARKANSAS' VALUABLE ENERGY

An Energy Curriculum For Arkansas' Schools

GRADES K-3


ARKANSAS DEPARTMENT OF EDUCATION

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LITTLE ROCK, ARKANSAS
1981

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## K-3: CONTENTS


**Lesson #1** (Sources). . Our Bodies Need Recharging, Too! (about food energy) **Subject areas:** Language Arts, Health, Physical Education, Science

**Lesson #2** (Sources). . The Incredible Worker--Energy (about different forms of energy) **Subject areas:** Language Arts, Science, Math

**Lesson #3** (Uses). . Who Needs Energy? (about people using energy at home and at school) **Subject areas:** Language Arts, Economics

**Lesson #4** (Conservation). . We Depend on Oil and Electricity **Subject areas:** Math, Reading

**Lesson #5** (Sources). . Electricity--There's a Trick to it! (about the use of fossil fuels to produce electricity) **Subject areas:** Language Arts, Science, Social Studies, Math

**Lesson #6** (Sources). . Yesterday's Fossils Fuel Today's Automobile **Subject areas:** Science, Art, Physical Education, Language Arts

**Lesson #7** (Limits and Impacts). . Danger! Unfit for Human Use! (Grade 3: about transportation pollution) Subject areas: Reading, Social Studies, Science

**Lesson #8** (Sources, Limits and Impacts). . The Best Present of All (an energy play) **Subject areas:** Reading, Language Arts, Science

**Lesson #9** (Conservation). . Let's Go Back in Time (a role play) **Subject areas:** Social Studies, Language Arts

**Lesson #10** (Sources). . Our Best Friend--the Sun **Subject areas:** Reading, Math, Art

**Lesson #11** (Conservation). . Let's Build a Sun Community **Subject areas:** Art, Math, Science

**Lesson #12** (Conservation). . Conservation Is the Key **Subject areas:** Language Arts, Art

**Lesson #13** (Conservation). . Willie the Waster **Subject areas:** Math, Social Studies, Language Arts

**Lesson #14** (Conservation). . Carefully Consuming Carol **Subject areas:** Social Studies, Language Arts, Math, Art, Reading

**Lesson #15** (Conservation). . Waste Uses Up Earth's Resources **Subject areas:** Math, Science, Language Arts

**Lesson #16** (Conservation). . What Can We Do About Waste? **Subject areas:** Language Arts, Economics, Art

## PREFACE

In recent years Arkansans and Americans have become increasingly concerned about the energy dilemma and its important role in their lives. New research and technology can alleviate part of the problem but an immediate source of relief can be the reduction of energy use. Effective energy conservation can result in substantial savings in energy consumption and extend the longevity of present energy supplies.

The energy situation provides almost endless possibilities for students to learn about the world, their nation, their state, and themselves. The comprehensive and complex nature of the energy situation provides an excellent base for the study of the interactions and relationships among resources, environment, economics, society, politics, and behavior.

Energy brings challenge and opportunity to education. The challenge is basic: preparation for survival. The opportunity is to learn from real world problems and to demonstrate how education can contribute to solutions.

The younger generation is the key to the solutions of our energy problem. They also stand to enjoy or suffer the conseqences of the problem. The subject of energy, containing some of the most crucial issues of our time, deserves a place in the school curriculum at all levels in all subjects. Energy is an essential element of everything we do.

Studying Arkansas' Valuable Energy represents an effort by the Arkansas Department of Education to assist the schools of Arkansas in planning and carrying out effective energy education programs. It is hoped Studying Arkansas' Valuable Energy will increase awareness and understanding of the energy situation and will encourage each student to become an energy conservationist.

Studying Arkansas' Valuable Energy is premised on the following:

**SOURCES, ALTERNATIVES, CONVERSIONS**

Individuals should understand that:

- there are many sources of energy.
- presently fossil fuels provide most of our energy sources but alternative sources including direct solar, hydro, wind, nuclear fission, biomass, geothermal, and nuclear fusion must be considered and/or developed.
- energy/matter is a fixed commodity being neither created nor destroyed but converted from one form to another; individuals should understand the means of conversion and the by-products of conversions.

**USES**

Individuals should understand that:

- energy is so basic that nothing moves or is accomplished without it.
- people are dependent upon energy.

- in the United States 75 per cent of our energy is derived from oil and natural gas; in Arkansas we have almost 90 per cent dependence on oil and natural gas.

**CONSERVATION**

Individuals should understand that:

- the supply of energy sources is finite; the need for conserving energy supplies is real and urgent.

- efficient use of energy resources is one of our best ways of maintaining our current life style.

- half the energy being used in the United States (and in Arkansas) is wasted.

**LIMITS AND IMPACTS**

Individuals should understand that:

- the earth's resources are limited.

- man's use of energy creates an impact on the environmental and economic systems.

Studying Arkansas' Valuable Energy is intended to aid Arkansas teachers in integrating energy education into existing curriculum. The lessons are designed to be used by classroom teachers in grade levels K-12. Most of the lessons require the students to be actively involved, both with other students and in actual use of materials.

The lessons have been designed with an interdisciplinary approach, and an attempt has been made to provide a flexible "package" which may be adopted or adapted to fit particular classroom needs. The instructor is free to modify lessons (or activities within lessons), and to use as many or as few lessons and activities as desired or needed.

Each lesson is uniformally organized as follows:

Category (Sources, Alternatives, Conversions; Uses; Conservation; Limits and Impacts)

Title

Related subject areas

Energy type(s)

Grade level

Time needed to complete lesson (in class periods)

Materials needed

Learning objective(s)

Task analysis (knowledge and skills required of students before undertaking a lesson)

Procedure

Preparation

Steps in lesson

Evaluation

Follow-up activities

These lessons are continually undergoing field testing and revisions to obtain the best possible materials to present to students. In the event that you, as a classroom teacher, wish to contribute more to the program of energy education, the Arkansas Department of Education will be happy to hear from you. Your comments and suggestions concerning subject matter, organization, materials, and activities will be welcomed.

There are evaluation forms included at the back of the unit. We request that each teacher who uses the lessons complete and return an evaluation form to the address given.

The Arkansas Department of Education wishes to thank the Arkansas Energy Office and in particular, Ms. Carol Gaddy, for reviewing and critiquing the many lessons of Studying Arkansas' Valuable Energy.

Curricular materials used in assembling Studying Arkansas' Valuable Energy include the following:

Energy and Man's Environment. Energy and Conservation Education: Activities for the Classroom Grades 1-12. Energy and Man's Environment: Portland, Oregon. 1978.

Indiana Department of Public Instruction. An Energy Curriculum for the Elementary Grades. Indiana Department of Public Instruction: Indianapolis. 1979.

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Oklahoma State Department of Education. Energy Awareness Education. Oklahoma State Department of Education: Oklahoma City. 1977.

Pennsylvania Department of Education. Pennsylvania Energy Curriculum for the Middle Grades. Pennsylvania Department of Education: Harrisburg. 1977.

Superintendent of Public Instruction. Energy Trade Offs in the Marketplace. Superintendent of Public Instruction: Olympia, Washington. 1980.

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United States Department of Energy. Various materials. Technical Information Center: Oakridge, TN.

## LESSON #1

**CATEGORY:** Sources

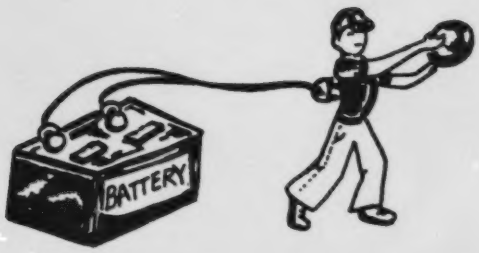
**ENERGY TYPE:** Food (chemical)

**TITLE:** Bodies Need Recharging, Too!

**GRADE LEVEL:** K-3

**SUBJECT AREA:**
Language Arts
Health
Physical Education
Science

**TIME NEEDED:** Two periods




**MATERIALS:**
Cereal boxes
Magazines
Drawing paper
Crayons

**OBJECTIVE:**

The students will discover that their bodies need food to produce energy.

**TASK ANALYSIS:**

Students should know the four food groups (meat, milk, bread, and fruit and vegetables) and should be able to draw a balanced meal.

**PROCEDURE:**

1. Preparation
   Read Teacher Background Information (1.4).
   Prepare duplicates of Student Worksheets 1.5 and 1.6
   Check library for filmstrip showing how the body uses food to produce energy.
   Display above listed materials.
   Use the following Bulletin Board Idea (optional).

| | |
|---|---|
| Bulletin Board Idea | Where We Get Our Energy<br><br>Make a bulletin board with the above title. As items such as beans, steak, bread, milk, etc. are added, have the class discuss them. |

2. Steps in Lesson
   Objective: The students will discover that their bodies need food to produce energy.

   a. Have the students lift or push several objects in the classroom (books, chalk, chairs, etc.). Help them recognize that work is being done and energy is being provided by their muscles.
      Ask: How do your muscles get energy? If one is available, show a filmstrip on how the body uses food to produce energy.

b. Take a walk on a nice day and have the students notice movement. Keep a list. When the class returns to the room, discuss what caused each movement they saw. They could then draw picutres of what they observed and post them on the bulletin board.

c. Let students participate in a series of physical exercises such as walking, skipping, hopping, jogging, running a certain distance. Then ask them to determine which method of movement required the most energy and why.

d. Display cereal boxes. Ask students why they eat cereal or other breakfast foods in the morning. Ask if other foods give them energy. Discuss that the body changes food into energy it can use. Have children locate pictures of food or people eating food, and pictures of things people can do with the energy they get from food. Have them glue these on paper--the food on one side, the activity on the other to show the relationship.

e. Distribute copies of Student Worksheet 1.5 and discuss how food becomes energy to do work.

f. Discuss with the students why it is important to eat the proper kinds of foods each day. Have them draw pictures of balanced meals including each of the four basic food groups: bread, meat, milk and fruit and vegetables.

g. Ask students where milk comes from. Use Student Worksheet 1.6 to illustrate.

h. Let students role play how they would feel without the proper nutrition.

Ask: How do you feel when you have been outside playing all day and have not eaten anything but a bowl of cereal in the morning? (tired, hungry) Make an analogy for students between their bodies and a worn out battery. Both need recharging when their energy runs out. And the body's fresh energy comes from food.

i. Have a student show something he could <u>not</u> do without eating properly.

3. Evaluation

Pass out drawing paper folded in half and have students get out crayons and pencils. Say: "Think about your favorite food. On the left side of the paper, draw a picture of yourself eating your favorite food. On the right side of the paper, draw something you can do with the energy from that food. (run, jump, turn flips, etc.) If you can, write a sentence about your picture." Use the pictures for a bulletin board, or language experience chart, or let the children take them home.

4. Follow-Up Activities

a. Careers: Invite school dietician to talk to the class about the importance of a balanced diet. He/She might also tell how a person becomes qualified to be a dietician.

b. Let students do a letter writing unit and practice by sending off for a free comic coloring book designed to teach children all about the foods they eat. Have them use postcards addressed to: Food Fun For Kids, Department RB, Box 355, Collingswood, NJ 08108. On the back of the card they ask for the free comic coloring book.

Sources:

Paul L. Butt, Arkansas and Energy: A Look at the Alternatives. Arkansas Ecology Center: Little Rock. 1979.

National Wildlife Federation. Energy: A Growing National Problem. National Wildlife Federation: Washington, D.C. 1978.

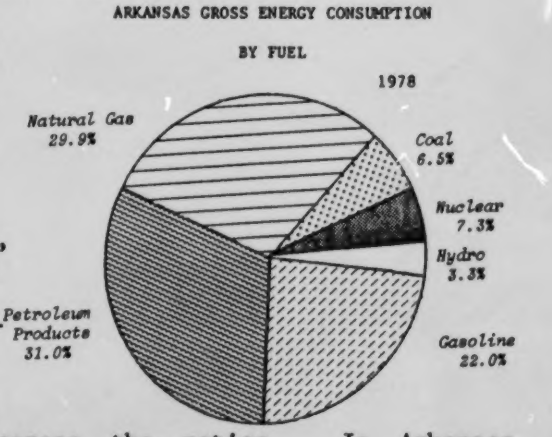
Energy makes things go.

It is required to move a person, move the car on the street or move a piece of machinery. Energy is found in many forms including mechanical, heat, light, electrical, chemical, potential and kinetic.

The connection comes when we realize that with one form we may store energy, with another we are transforming energy, and with another we are perhaps able to transport energy from one place to another.

An average person in the United States today uses as much man-made energy as 25 people in some other nations. For air conditioning alone, Americans use as much energy as 800 million Chinese people use for everything.

Almost all the energy used in the United States (more than 95%) comes from the burning of fossil fuels--coal, oil and natural gas. Three-fourths of the nation's energy comes from oil and natural gas. Arkansas depends on these two sources for almost 90% of its energy. See the diagram below.




Petroleum is the most important of the fossil fuels because it is not only used as a fuel but also as an ingredient in making many products such as packaging, nylon, fertilizers, plastics, fibers and pharmaceuticals.

Arkansas is 43% energy self-sufficient, but supplies of oil and natural gas are declining, thus presenting a challenge. The good news is that Arkansas has many alternative sources of energy to develop and use.

Already hundreds of thousands of solar water and space heating systems are in use across the nation. In Arkansas, about 500 homes are making use of both passive and active solar energy. These two methods will be discussed in greater detail in the lesson on solar energy.

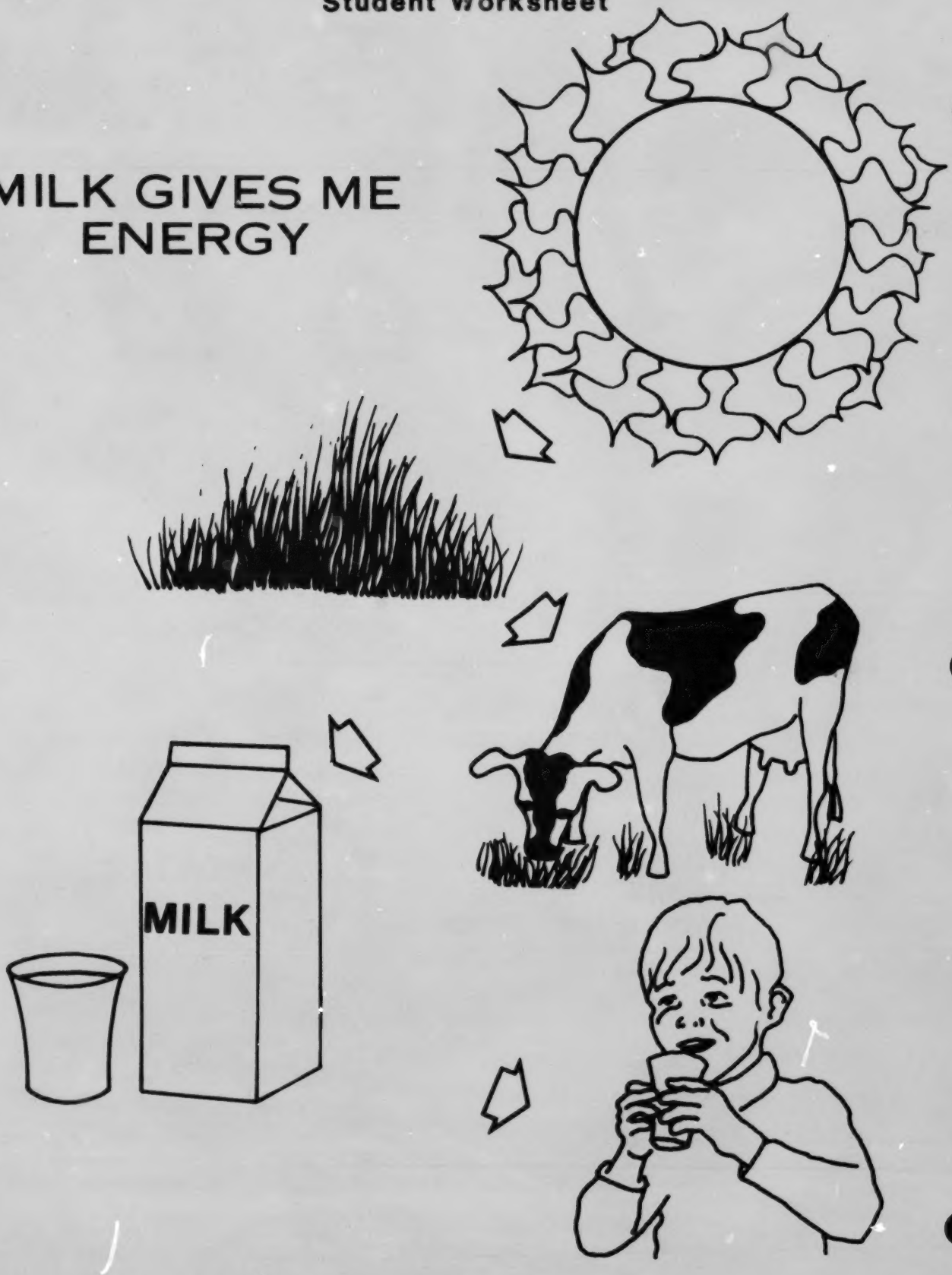
Today, we hear so much about energy. It is important to us because we use it each day in many different forms. Energy cannot be seen but we can see what it does. Children will have heard the term "energy" used in a variety of ways--certain things give them "lots of energy" and they may "feel full of energy". A simple definition such as the one suggested above will suffice: Energy makes things go.

Primary children need to experience simple hands-on activities through which they can learn about energy and how to conserve it. They can best do this by studying how energy affects their own lives and families.

## Student Worksheet

**Source:** Nebraska Energy Office

# MILK GIVES ME ENERGY




**Source:** Nebraska Energy Office

## LESSON #2

**CATEGORY:** Sources

**ENERGY TYPE:** Light, Heat, Mechanical and Electrical

**TITLE:** The Incredible Worker--Energy

**GRADE LEVEL:** K-3

**SUBJECT AREA:**
Language Arts
Science
Math

**TIME NEEDED:** Four 30-minute periods

**MATERIALS:**
Electric fan
Hammer
Some nails
Board
Popcorn popper
Popcorn (for everyone in class)
Rubber bands
Candle
Kerosene lamp
Electric light bulb
Sandpaper
Wind-up toy car
Some straight pins
Drinking straws (one for each student)

**OBJECTIVES:**

1. The students will understand that energy is the ability to do work; it can light, heat and move things.

2. The students will show that they can follow simple oral directions by making a pinwheel.

3. The students will learn to construct a simple bar graph using data collected during an energy experiment. (Grade 2-3)

4. The students will learn to classify forms of energy into one of the four categories studied: heat, light, mechanical and electrical.

5. The students will show their understanding of the different forms of energy by writing (grade 3) or dictating to their teacher (grades K-2) sentences describing the energy pictures on Student Worksheets 2.8-2.14.

**TASK ANALYSIS:**

The students should be able to cut and paste; follow simple oral directions; write or copy sentences; understand the vocabulary terms "fuel" and "electric generator"; ard measure to the nearest inch.

**PROCEDURE:**

1. Preparation

Read Teacher Background Information (2.6).
Collect and assemble materials listed above.
Duplicate Student Worksheets 2.7-2.17.
Staple class sets of energy coloring book using Student Worksheets 2.8-2.14.

If time permits, make a display of mechanical devices using ideas from your science text. This allows students to touch and use such simple machines as levers, pulleys, hammers and inclined planes.

2. Steps in Lesson

Objective #1: The students will understand that energy is the ability to do work; it can light, heat and move things.

a. (Light) Burn a candle, kerosene lantern and an electric light bulb. Ask students which one gives the most light and which gives the least. Discuss what fuel is used to make the light in each case (wax, kerosene, and electricity). Ask if they can tell about what time in history each method of lighting was used. Have students check the encyclopedia for more about types of lighting uses throughout history. (Grade 3).

b. Have students collect pictures of as many different lights as they can find. Ask them to point out the types of lighting used mainly in the past.

c. (Heat) Hit a nail into a board with a hammer or pull one out. Ask a student to touch the nail and tell what it feels like. (It should feel warm.) Have another student compare the nail to one which has not been pounded.

d. Sand a board with sandpaper. Let a student feel the board and tell what has happened to it. (It should be much warmer than before.) Explain that hitting the nail, pulling it out and sanding the board involved movement (mechanical energy) which produced heat (friction).

e. Have students rub their hands together vigorously. The friction between their hands will cause them to become very warm. Explain that mechanical energy (provided by their muscles) is changed or converted to heat energy.

f. Light a candle. Ask a student to hold one end of a nail while touching the other end to the flame of the candle. Soon the nail becomes too hot to hold. Ask students how the heat traveled from the flame to their hand. Explain that this is called "conduction".

g. Pop popcorn and talk about energy--how it is hidden in the kernel (potential) and is released. There is water in each kernel of corn which, when heated, converts to steam. The kernel expands and pushes against the tough skin of the kernel. Soon the kernel explodes and you can see the white starch of the inside kernel. If you use butter, note the conversion of butter from solid to liquid form when subjected to heat energy. Remember to tell students that when they eat the popcorn it becomes fuel for their own body energy.

h. (Motion--mechanical energy) Discuss simple machines which use mechanical energy such as a hammer, lever, pulley and inclined plane. Make a display using examples of these simple devices so students can touch and see how they work. (Most science texts give examples of some simple machines that can be set up easily.)

i. (Motion--electrical) Turn on an electric fan that has been unplugged. When nothing happens, ask students what is missing. Help them understand that the form of energy (electricity) is missing. Then plug in the fan and show that electricity makes the fan move.

j. Have several students put their hands under a faucet to feel the force of water. Explain that this kind of force is often used to turn wheels which generate electricity. Ask if they have ever put their hands in a creek with swiftly running water? In a pond with still water? How do the two compare? Ask students which one would make more electricity, moving water or still water?

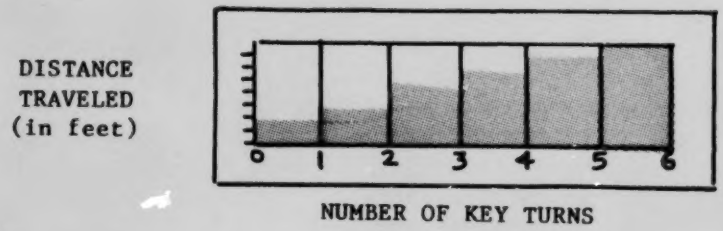
Objective #2: The students will show that they can follow simple oral directions by making a pinwheel.

a. Pass out the pinwheel pattern (Student Worksheet 2.7). Help students cut out the pattern. Tell them to cut along the lines going toward the center but to stop when the lines stop. Pass out pins and straws. Tell students to put the pin through the paper pattern ends with the dots on them and then through the straws.

b. When all pinwheels are finished, ask several students to hold them in front of the electric fan to feel and see the force of wind energy. If there is enough wind outside, let students take their pinwheels out to experience natural wind energy.

Objective #3: The students will learn to construct a simple bar graph using data collected during an energy experiment. (Grades 2-3)

a. Wind up a toy car and release it. Have students measure the distance the car travels. Do this several times varying the number of times the key is turned. Record and compare the answers. Have a student demonstrate how to make a bar graph showing the results. (Students should notice that the amount of energy stored increases with the number of times the key is turned.)




Objective #4: The students will be able to classify forms of energy into one of the four categories studied: heat, light, mechanical and electrical.

a.

Bulletin Board Idea

Have students draw things in the classroom that use energy. Collect and sort the drawings into appropriate categories--heat, light, mechanical, electrical. Label and place on bulletin board.

Objective #5: The students will show their understanding of the different forms of energy by writing (Grade 3) or dictating to the teacher (Grades K-2) sentences describing the energy pictures of Student Worksheets 2.8-2.14.

a. Pass out student coloring books (made up of Student Worksheets 2.8-2.14) and discuss the title "We Know Energy Because of What It Does." Have students write or dictate sentences describing how energy is being used in each picture. Write these sentences on the chalkboard and give students time to copy them under each picture.

3. Evaluation

Pass out Student Worksheets 2.15 and 2.16 and read directions aloud. These may be used to measure how well students understand energy as motion, heat and light.

4. Follow-Up Activities

Pass out Student Worksheet 2.17. Use the following instructions:

Mark everything on the picture that moves with an M.
Mark everything that lights with an L.
Mark everything that gives off heat with an H.
Mark the waterfall with an ME, for mechanical energy.
Mark the energy flowing through the transmission wires with an E, for electrical.

## TEACHER BACKGROUND INFORMATION

Energy has been defined in many ways, but a useful definition is that energy can heat, light and move things. When it is used to create heat, light, or motion it is called kinetic energy. When it is stored--in coal or food, for example--it is called potential energy. There is potential energy in fossil fuels, in a battery or in water in a reservoir above a dam.

Energy takes many forms, and it can change from one form to another. The sun's energy is radiant, or light, energy. The waterfall that turns the turbine of the electrical generating plant is mechanical energy. The electricity that travels through the transmission wires is electrical energy.

The heat energy in the kitchen range cooks the food causing it to change form by chemical energy. Your body, after eating the food, uses this chemical energy to make you move (mechanical energy) and to keep you warm (heat energy).

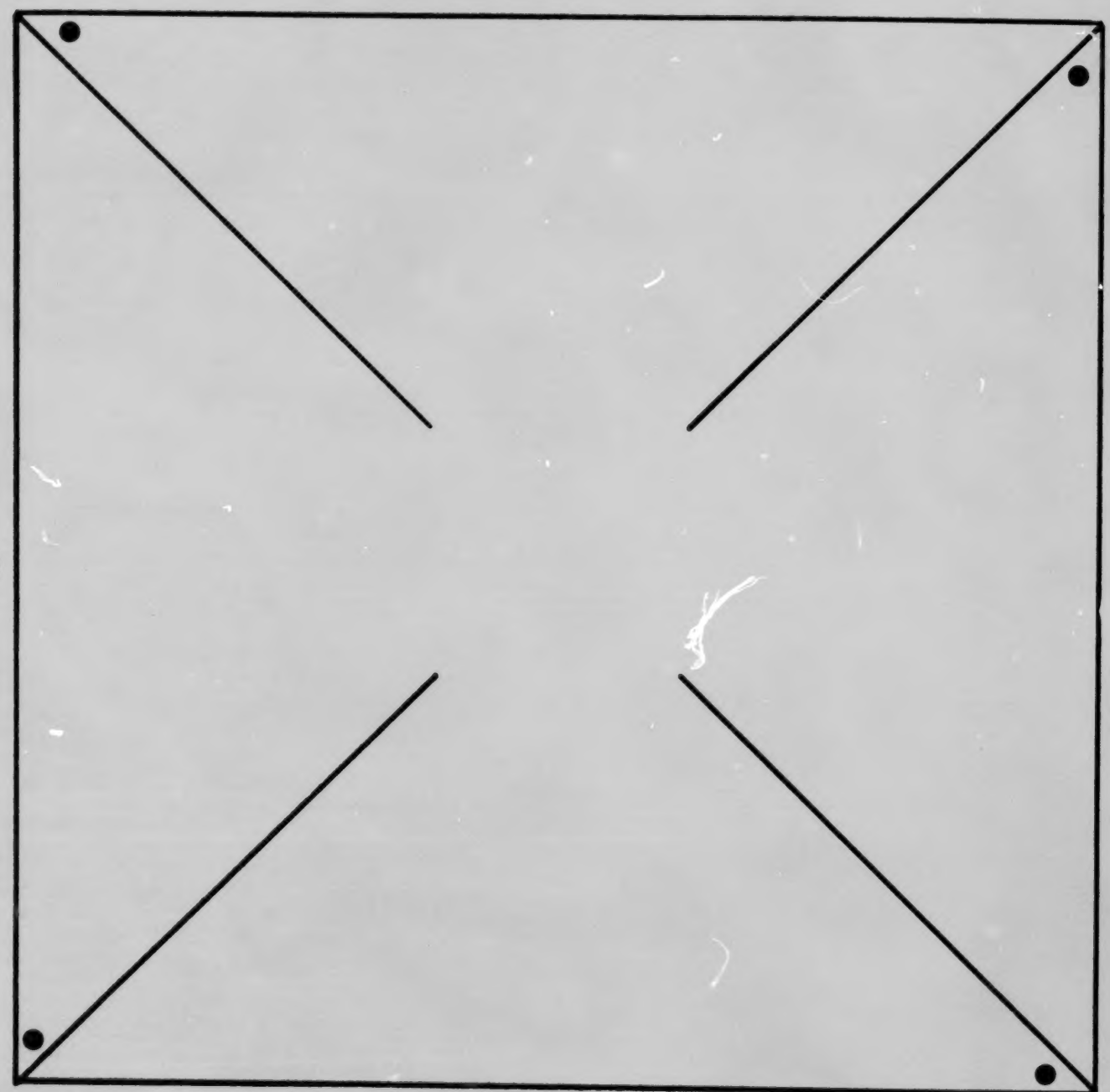
Whenever energy changes from one form to another, some of that energy dissipates into the environment in the form of heat, and so is wasted. The more steps between the source and its use, the more energy is lost along the way.

Some of the sources for energy in the world are essentially inexhaustible. They will (for all practical purposes) always be there--like the sun. And some energy sources, once used, cannot be grown or created again. These are called nonrenewable energy sources. Some examples are coal, oil, natural gas and uranium.

Although one cannot see energy, one can see what it does. It heats, lights and moves things.

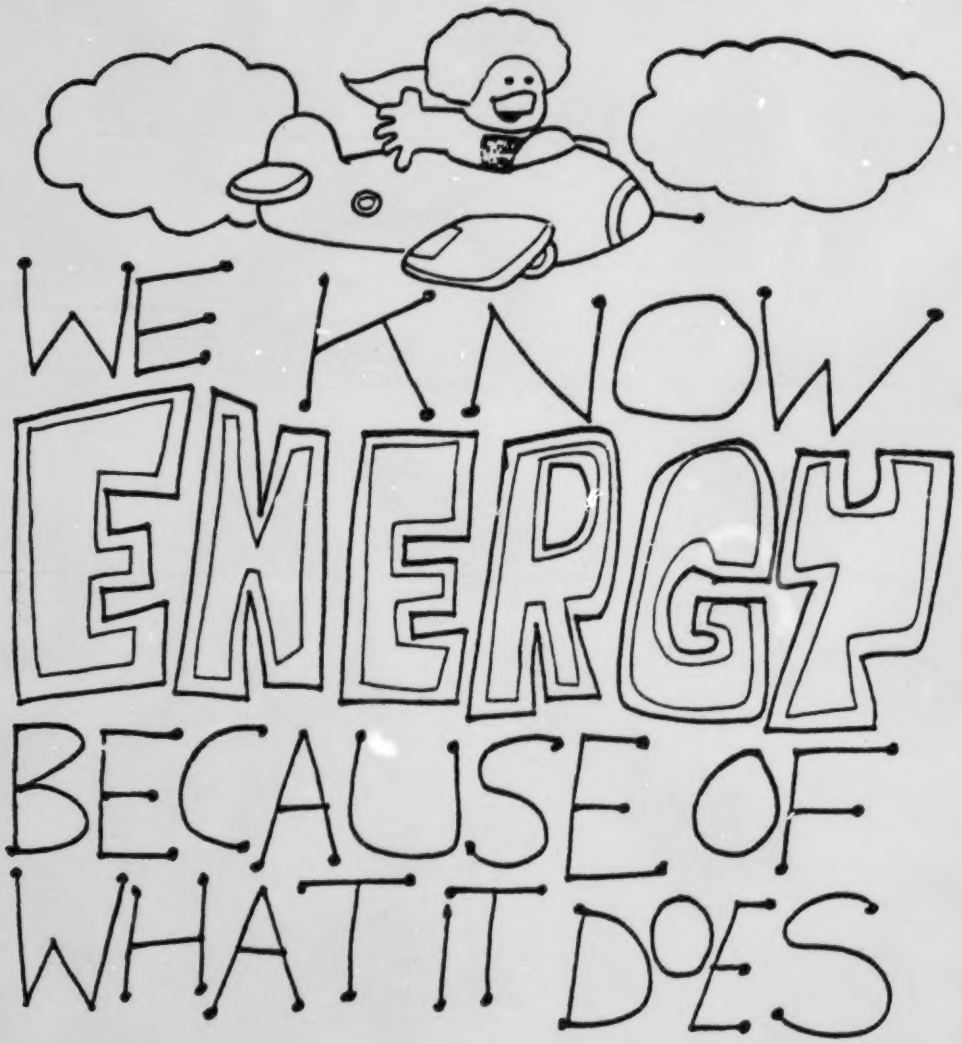
# Student Worksheet

## Pinwheel Pattern



## Student Worksheet

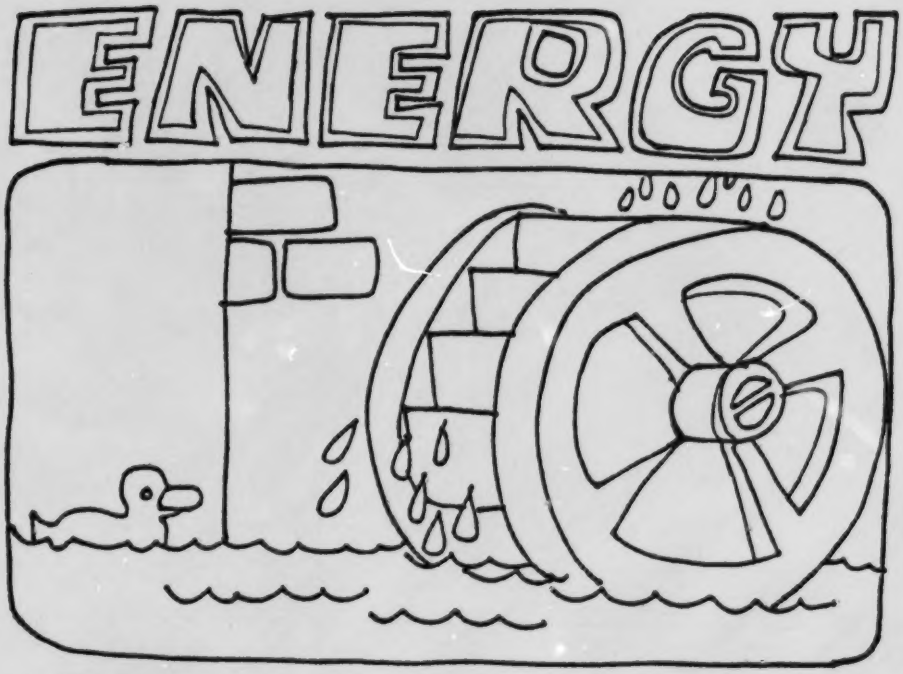
**Energy Coloring Book**

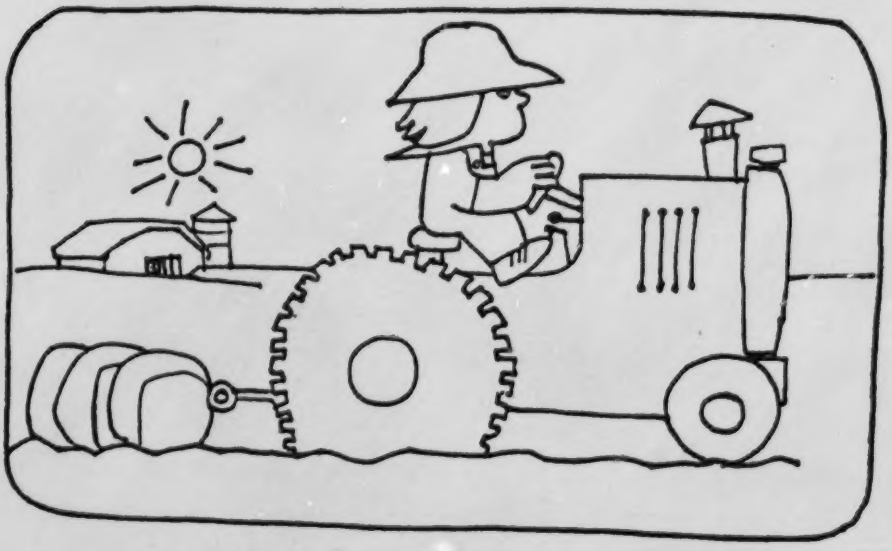


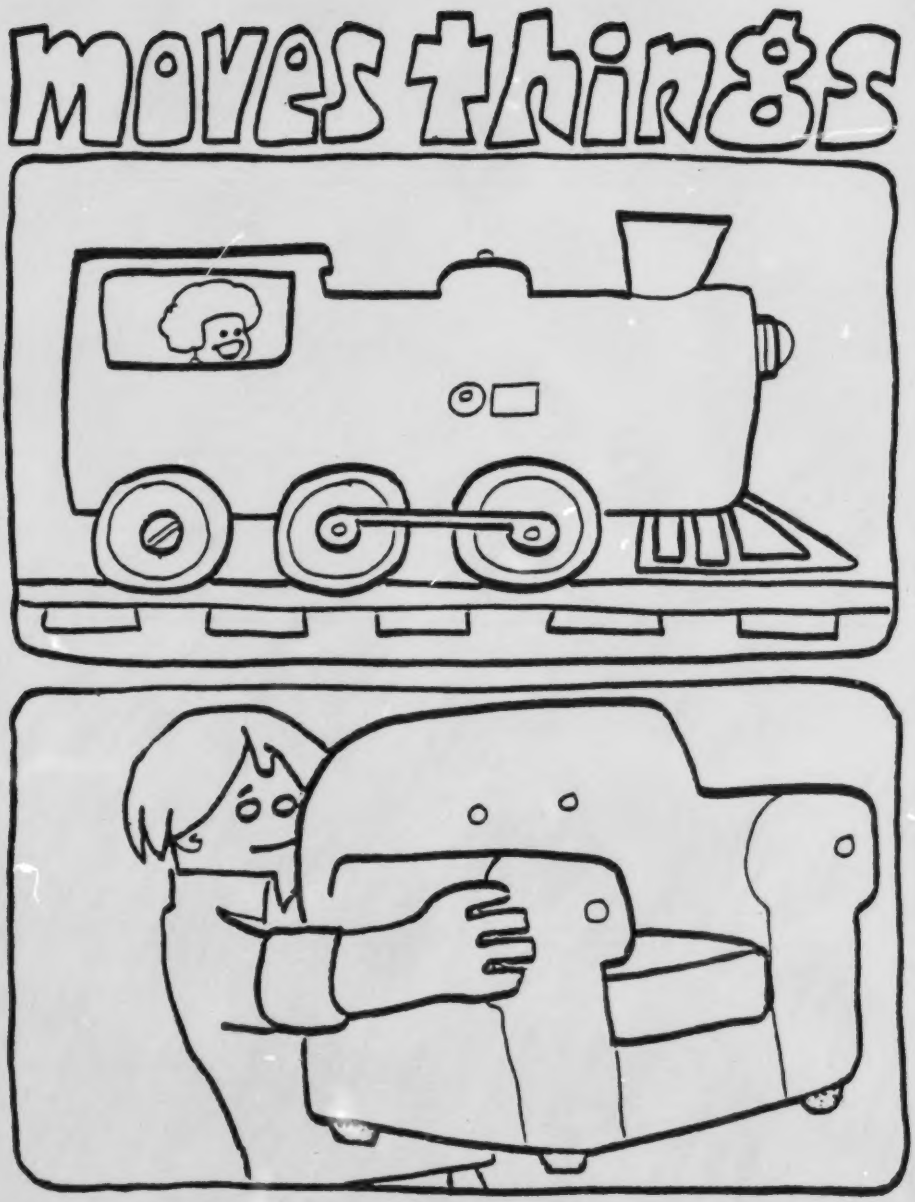

**Source:** Oklahoma State Department of Education

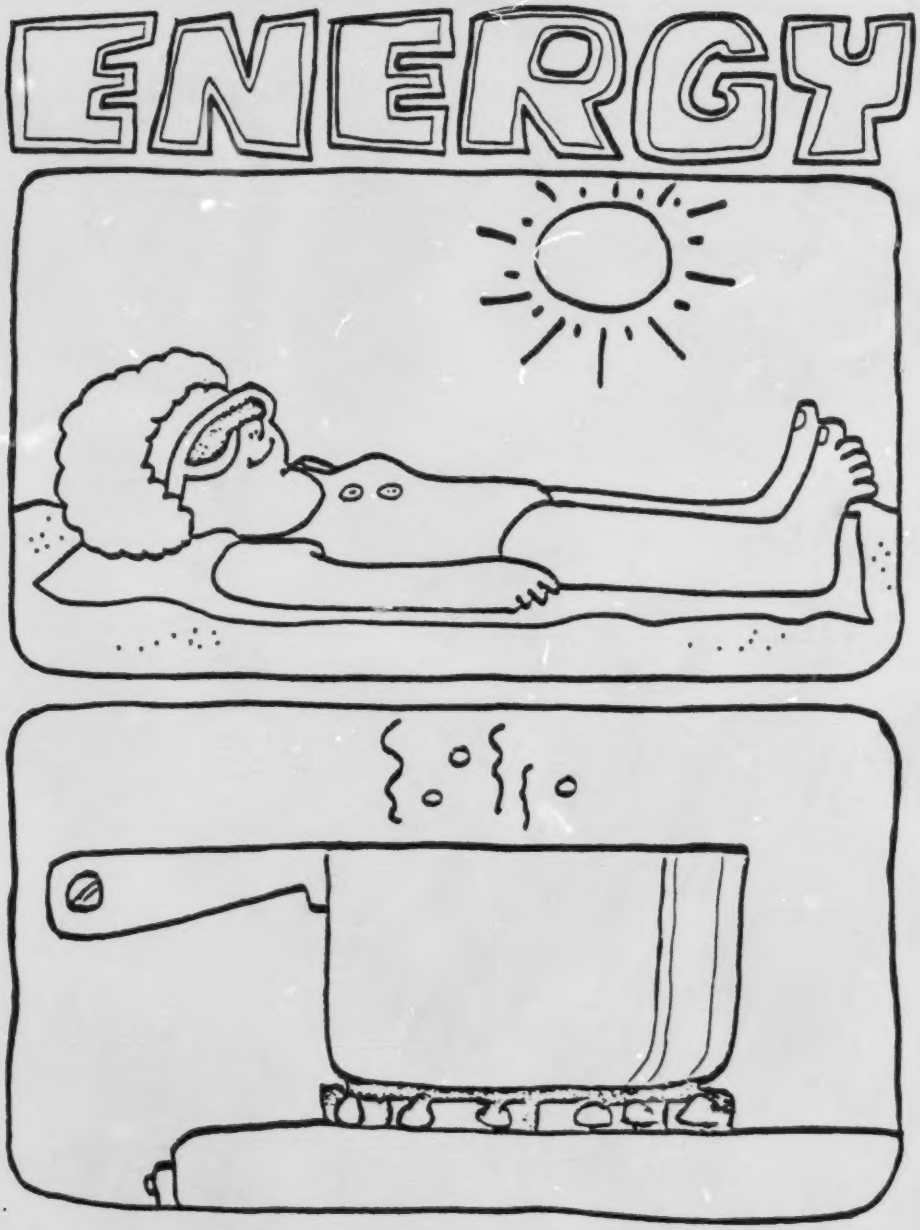
## Student Worksheet

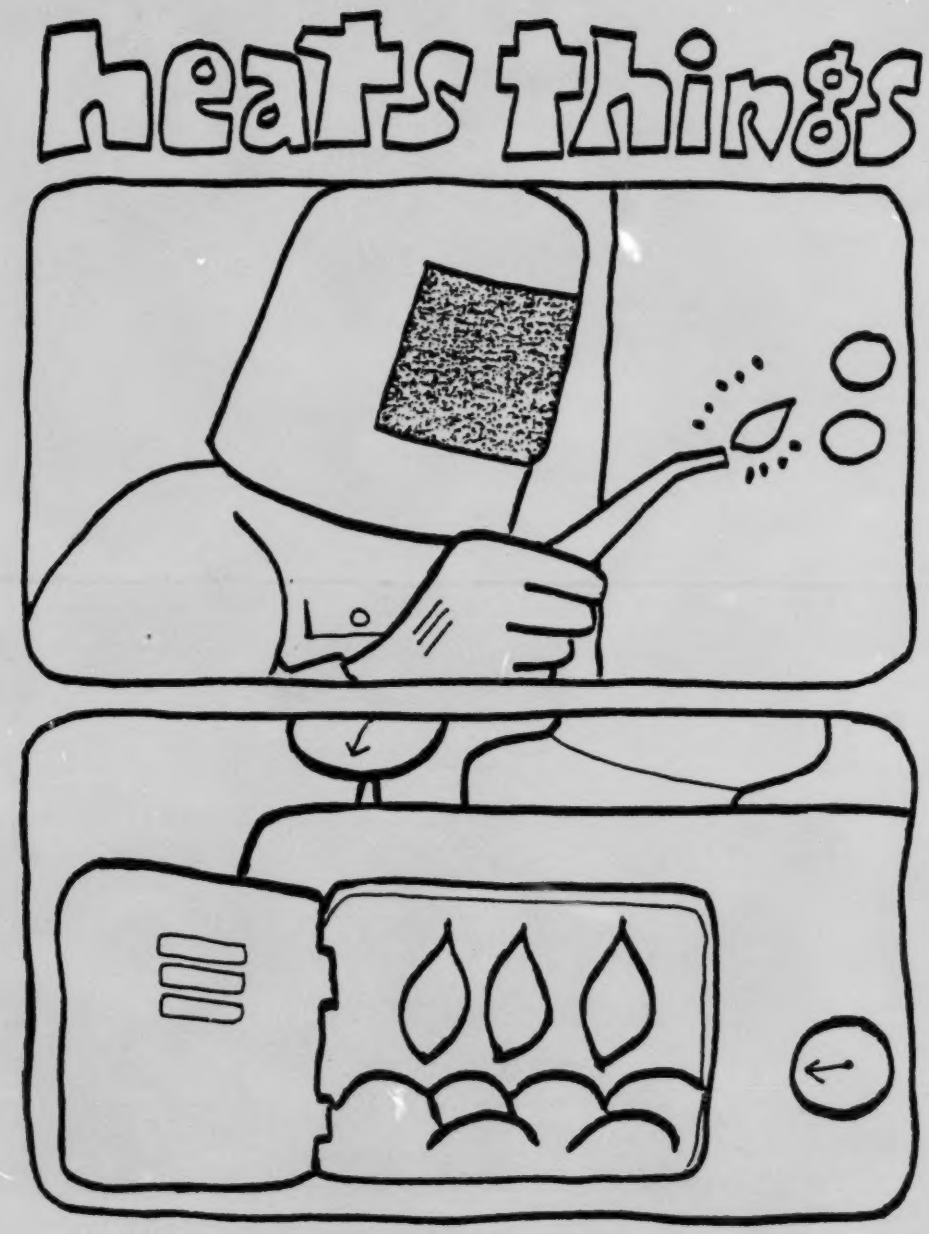
**Energy Coloring Book**



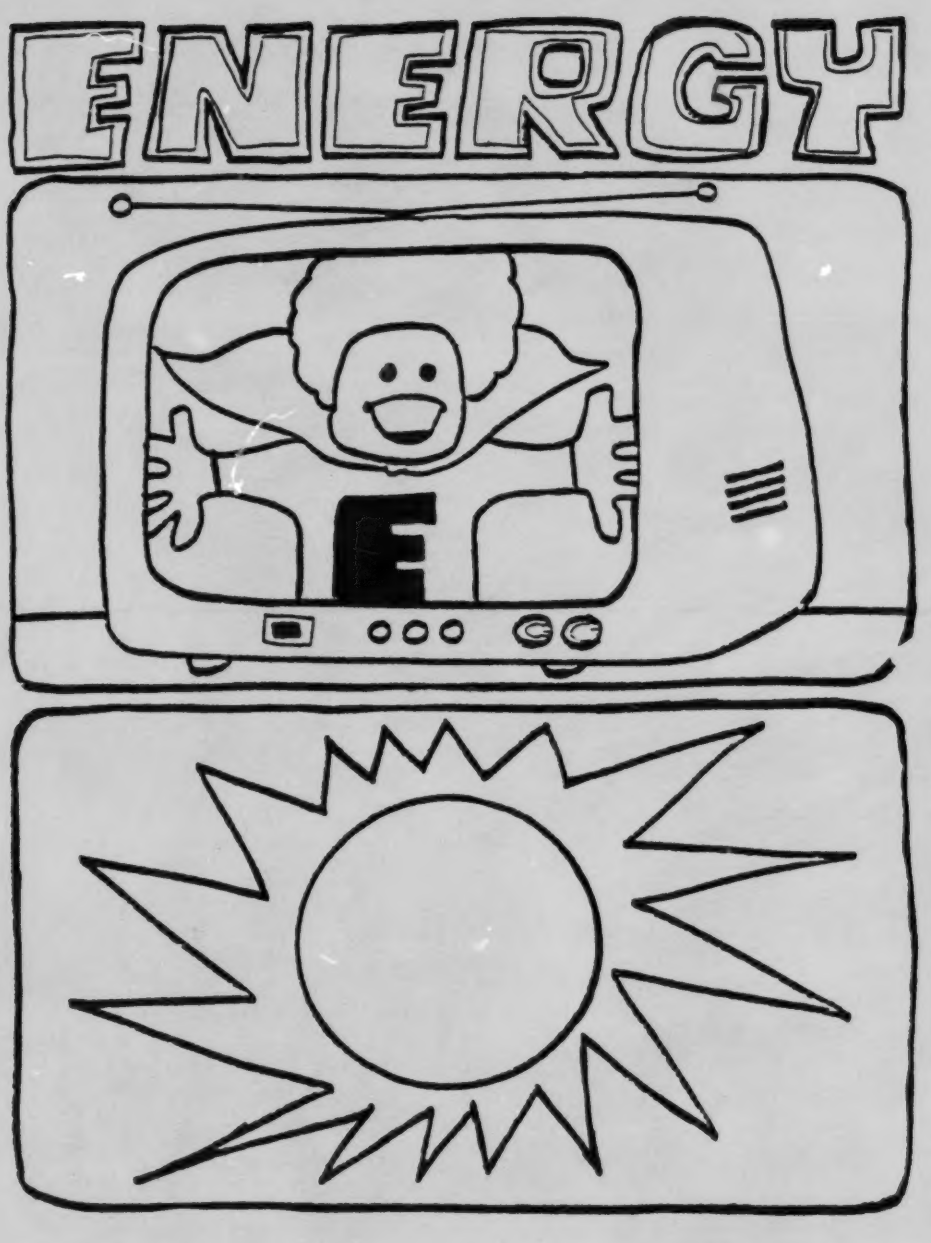

moves things

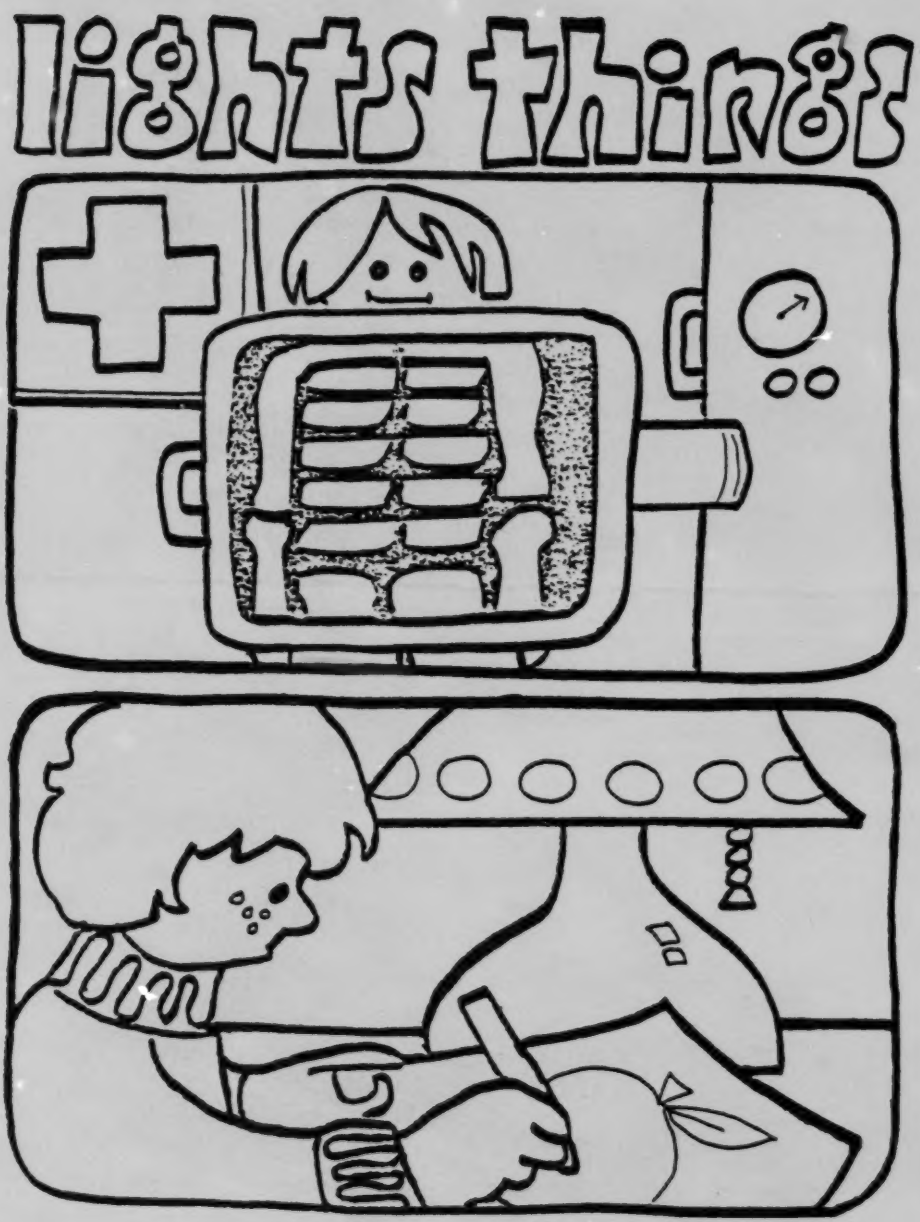

ENERGY


heats things

## Student Worksheet

**Energy Coloring Book**

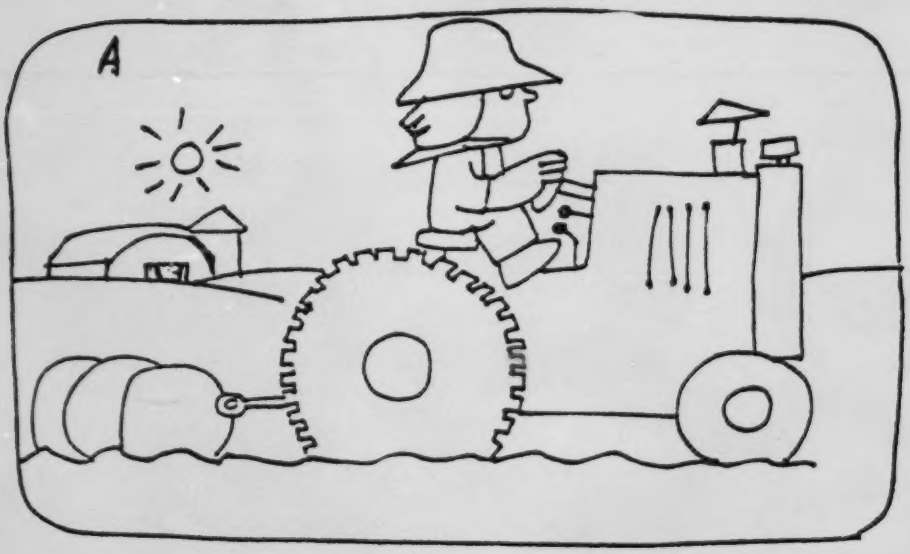



lights things

# ENERGY IN USE

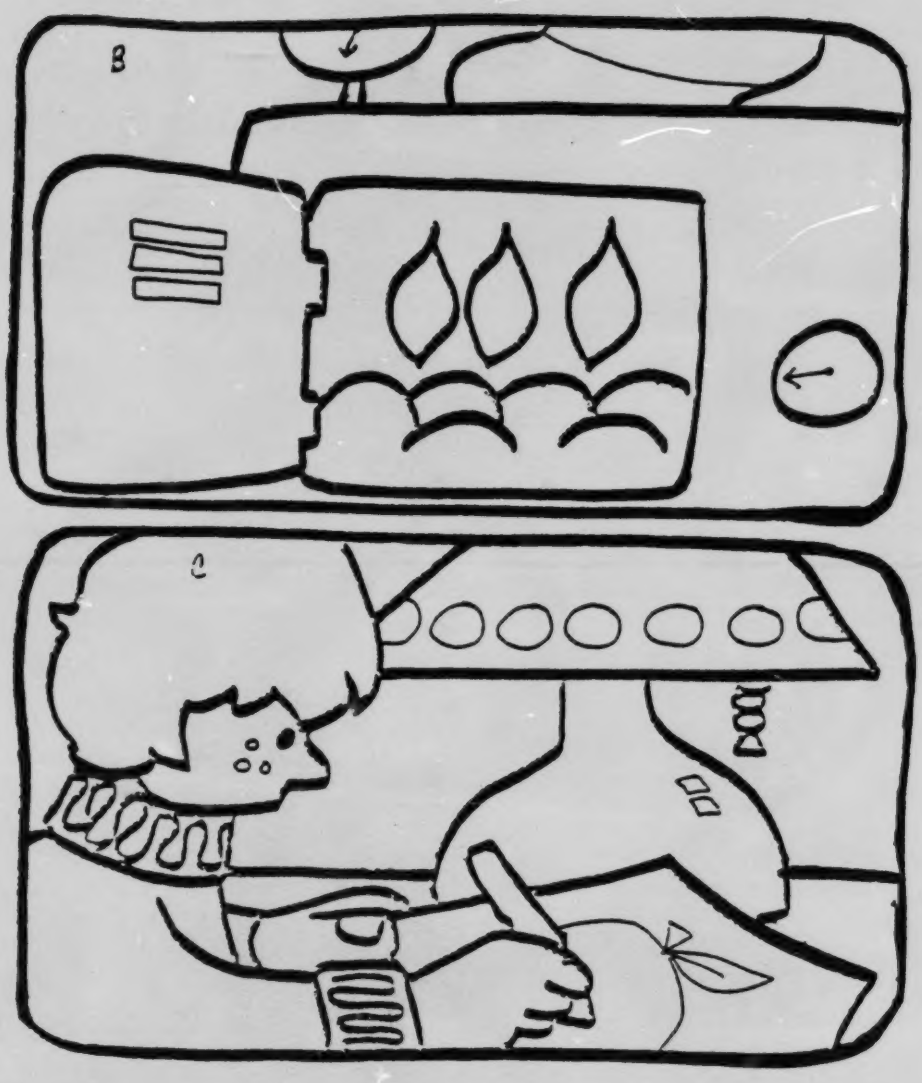
Look at each picture and decide how energy is being used. Write A, B, or C by the correct form of energy:

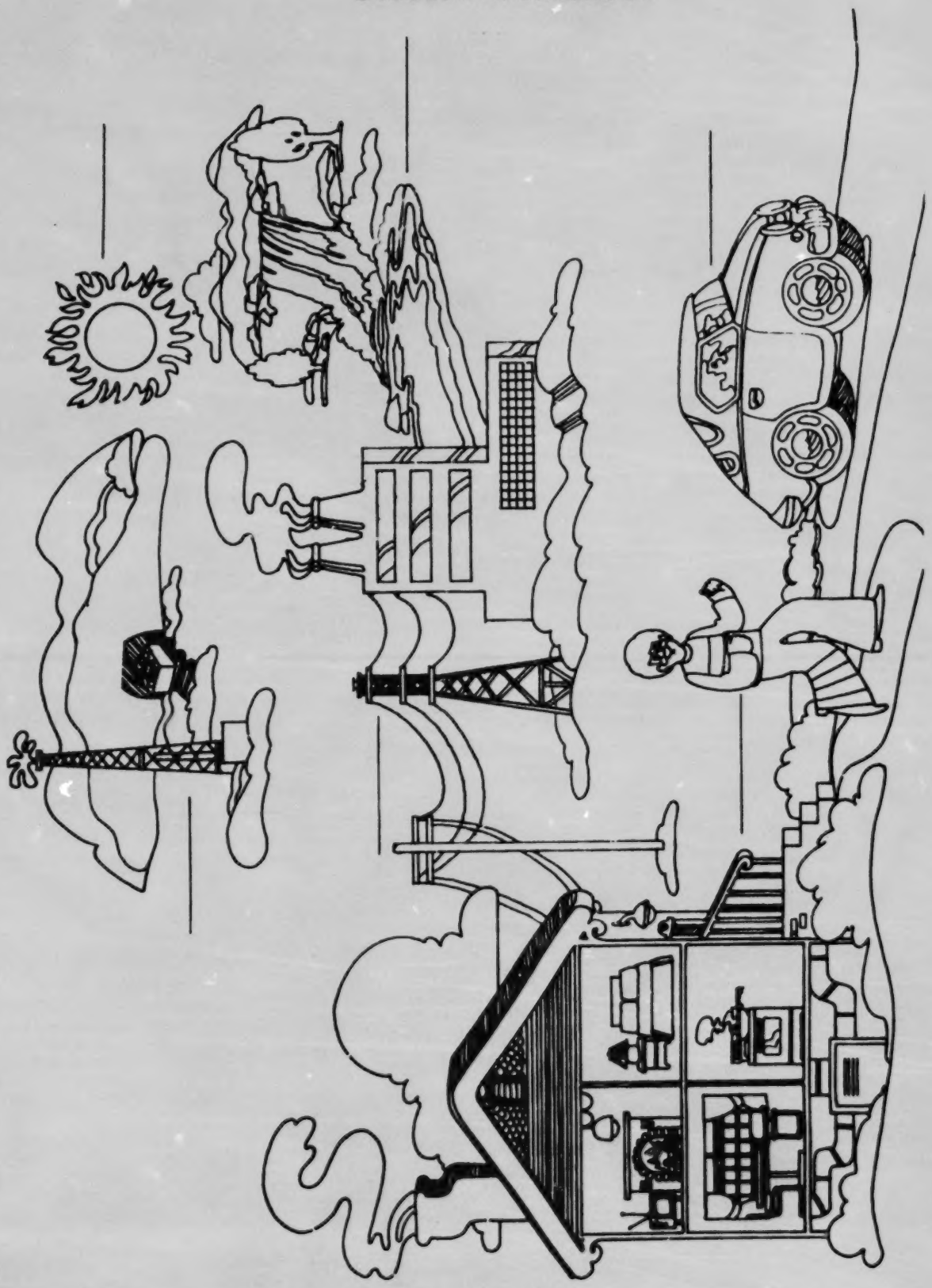
____ 1. Motion
____ 2. Heat
____ 3. Light






Source: Oklahoma State Department of Education


B
C



## TO THE TEACHER

**Read the following story through to the students in your class as they look at the picture on their activity sheets. Then ask them to mark their copies as you direct them.**

This is a story about the world you live in. Every day--whether it's cloudy or bright--the sun shines on your world to create heat and light to support plant and animal life. The heat and light from the sun grows our food, creates the winds and waterpower, and even, many millions of years ago, was the source of energy for the decayed plants and animals that made the fossil fuels called oil, coal, and natural gas.

The people in your world go to their jobs and go to school; they play. And when the sun sets at night, they are tired and they say,"Whew, I ran out of energy!" In the morning, after a good night's sleep and a big breakfast, the people in your world feel "full of energy" again.

Just what is energy, anyway? This picture shows all kinds of energy. Energy is the power to make things move; energy creates light; and energy makes heat. Energy does work. And, in scientific terms, work is not just those things we do that we don't want to do like math or scrubbing the kitchen floor; work is any time a force causes an object to move or change in some way.

Energy takes many forms, and it can change from one form to another. The sun's energy is radiant, or light energy. The waterfall that turns the turbine of the electrical generating plant is mechanical energy. The electricity that travels through the transmission wires is electrical energy. The heat energy in the stove in the house cooks the food in the pan causing it to change form by chemical energy. Your body, after eating the food, uses this chemical energy to make you move (mechanical energy) and to keep you warm (heat energy).

Whenever energy changes from one form to another, some of that energy disappears into the atmosphere in the form of heat, and so is wasted. Because of the constant changing of energy from one form to another--radiant to mechanical to electrical to heat energy to chemical energy, for instance--no living or non-living thing is 100 percent efficient in its transfer of useful energy; and the more steps between the source of the energy and its use, the more energy is lost along the way.

Some of the sources for energy in your world are inexhaustible. They will always be there--like the sun. And some energy sources, once used, cannot be grown or created again. These are called nonrenewable energy sources. Some examples are coal and oil. The challenge for all of us in our energy world is to use these energy sources carefully and make them last as long as possible.

**Source:** United States Department of Energy

## LESSON #3

**CATEGORY:** Uses

**ENERGY TYPE:** Electricity

**TITLE:** Who Needs Energy?

**GRADE LEVEL:** K-3

**SUBJECT AREA:**
Language Arts
Economomics

**TIME NEEDED:** Two 30-minute periods

**MATERIALS:**
Some items powered by electricity (a fan, a toothbrush, a toaster, an iron, a radio)
Magazines to cut up

**OBJECTIVES:**

1. The students will learn some uses of energy in the home.

2. The students will learn some uses of energy in the school.

3. The students will compare uses of energy and will evaluate their own energy consumption.

**TASK ANALYSIS:**

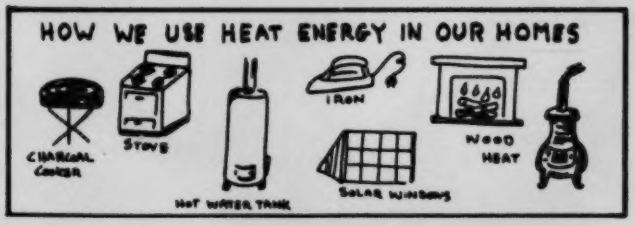
Students should be responsible for completing homework involving home energy use; be able to read and copy down the wattage printed on light bulbs; and be introduced to the following vocabulary: Alternatives, Conservation, Consumption, Utility Company, Watt.

**PROCEDURE:**

1. Preparation

   Read Teacher Background Information (3.4)
   Duplicate Student Worksheets 3.5-3.17.
   Staple Student Worksheets 3.11-3.15 to make a student booklet.
   Assemble other materials listed above.

Bulletin Board Idea




Start a bulletin board display entitled "How We Use Heat Energy in Our Homes". Set up columns for different fuels suggested by the students: natural gas, gasoline, oil, wood, charcoal, solar, electrical, propane. Attach the pictures to the appropriate columns. Or simply display pictures in a collage.

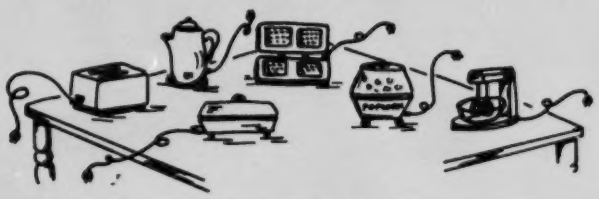
2. Steps in Lesson

Objective #1: The students will learn some uses of energy in the home.

a. Pass out Student Worksheet 3.5 (Energy Inventory). Talk about each picture. Have students circle each picture that shows a way in which they use energy in their homes. (The blank may be used to draw another way not shown.)

b. Using Student Worksheet 3.6 students can keep track of each time they use electricity. Send the sheet home on a weekend with a note to the parents explaining what the students are doing. Ask that these be returned by Monday.

c. Make a display of items that are powered by electricity. Allow time for students to observe and ask questions. Ask them to decide which of the items could be eliminated and what they would use instead of that item. Pass out Student Worksheets 3.7 and 3.8 and have students fill in the blanks (Grade 3). Pass out Student Worksheets 3.7 and 3.8 and help students fill in the blanks (Grades K-2).



d. Distribute copies of Student Worksheet 3.9, a picture of people sitting around a campfire. Ask what the main uses of the campfire are. Students will probably say to cook, to produce light and to keep warm. Ask students how many different things they think they have in their houses to perform the basic functions of cooking, lighting and heating. Their guesses will probably cover a broad range. Have students cut out from magazines everything they can find that helps people use heat energy. After many pictures have been collected, recall the campfire, and ask what fuel was used to provide the energy needed for most the items in the pictures. (These pictures may be used again on the bulletin board suggested at the beginning of the lesson.)

Ask:
What are the advantages and disadvantages of using a campfire for cooking and heating?
Which column on the bulletin board has the most pictures?
How many of the jobs done by the appliances shown on the board could have been done without using an appliance at all?
Why do Americans use all these different items?
What do you suppose is happening to our supplies of fuel?

Objective #2: The students will learn some uses of energy in the school.

a. Invite the school custodian into the classroom to talk about how he/she uses electricity to do his/her work at school. He/She could also explain how different his/her work would be without electricity. Ask him/her what he/she has done to help the school save electricity. Ask him/her to help the students plan ways they can save electricity or other energy in their classroom.

b. Using Student Worksheet 3.10 to record findings, have students take an "Energy Walk Through the School."

c. With the help of parents and teacher, students can look at the wattage printed on light bulbs at home and at school. They can read the figures, add them up, and compare home consumption with their own classroom consumption. Ask if they can think of reasons for a difference. (Most homes use incandescent lighting while schools use fluorescent lighting; not as much light is needed in homes because family members are not constantly reading and writing and when they are, lamp lights are used to light small areas.) Tell students that a 25-watt fluorescent bulb gives off as much light as a 100-watt incandescent bulb, but costs one-fourth as much to light.

Ask: What are things you can do to save electricity used for lighting? Perhaps someone from the electric utility company might be invited to talk about ways to save electricity.

Objective #3: The students will compare uses of energy and will evaluate their own energy consumption.

a. Have students bring to class catalogs and magazines. Have them cut out pictures of things that need electricity and place these pictures into two groups--those their families need and those "extras" they want. Discuss with students the idea of necessities (needs) and luxuries (wants). After students classify the pictures, they should choose the electrical items they cannot do without. Use the pictures to make a collage or mobile.

3. Evaluation

a. Pass out student booklets (made from Student Worksheets 3.11-3.15). These pages help develop the idea that energy does many things. Discuss the concepts as the students work through the book coloring the pictures. Have students tell what kind of energy is being used in each picture.

b. Have students use Student Worksheet 3.16 to determine the different uses of energy in their homes and rank them from highest to lowest use. (This could be sent home over the weekend.) Have students compare their lists on Monday and discuss what this shows about each family's lifestyle. Compile a class list of the most used items and how students use them.

4. Follow-Up Activities

a. Do Energy Puzzle on Student Worksheet 3.17. (Grade 3).

Source:

Tenneco Inc. Schoolhouse Energy Efficiency Demonstration (SEED). Tenneco Inc.: Houston. 1979.

The problems with school lighting fall into several categories: the use of inefficient types of lights, the use of too much artificial light and poor quality lighting.

It is widely known that incandescent lights use more energy and last a shorter time than standard fluorescent lamps. In recent years a more efficient fluorescent lamp has been developed. Moreover, for exterior lights and areas where the quality of light is not critical, e.g., gyms and cafeterias, multivapor and high pressure sodium lamps have been developed. These are even more efficient users of energy.

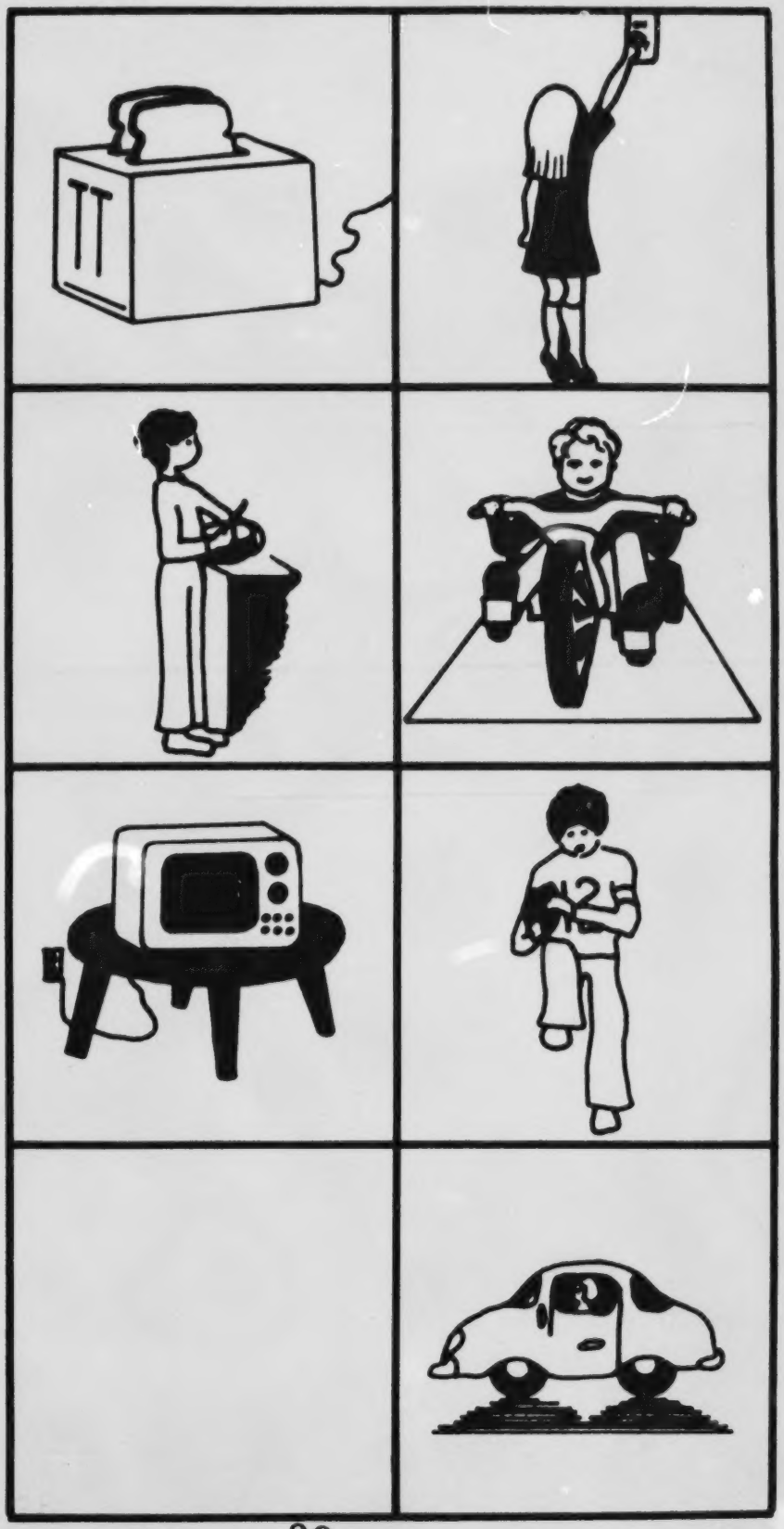
| | COST | RELATIVE EFFICIENCY | HOURS | COLOR QUALITY |
|---|---|---|---|---|
| Incandescent | Low | 1 | 1,000 | Good |
| Fluorescent | Moderate | 4 | 20,000 | Good |
| Mercury Vapor | High | 3 | 20,000 | Fair |
| Multivapor | Very High | 4 | 15,000 | Fair-Good |
| High Pressure Sodium | Very High | 5 | 20,000 | Poor |

Most schools are over-illuminated with artificial light. It is recommended that all unnecessary lights be turned off and ballasts be disconnected. Further, artificial light is used near windows where sufficient daylight is available for reading and writing. Use of a light meter will quickly determine which lights are unnecessary. Acceptable lighting levels are 70 footcandles for task or close work, 50 footcandles for general areas, and 20 footcandles for corridors.

Usually classroom lights are arranged in three rows of fluorescent lamps, parallel to the window. Each row can have a separate switch. To take advantage of the daylight, leave window shades open and turn off the row of lights closest to the window. This simple procedure can reduce electric power consumption by 10 to 25 per cent.

# Energy Inventory

## How Do You Use ENERGY?



**Source:** Nebraska Energy Office

**Student Worksheet**

# HOW DO I USE ELECTRICITY?

| | What I Used That Used Electricity | The Reason I Used Electricity |
|---|---|---|
| (example) | 1. Washer | 1. Clean clothes |
| | 2. | 2. |
| | 3. | 3. |
| | 4. | 4. |
| | 5. | 5. |
| | 6. | 6. |
| | 7. | 7. |
| | 8. | 8. |
| | 9. | 9. |
| | 10. | 10. |



**Source:** Nebraska Energy Office

# ALTERNATIVES

Think of something and then think of what could be used in place of the first item. A few examples are listed.

| | |
|---|---|
| vacuum | broom |
| car | bicycle |

# CONSERVATION

Name _____

Sometimes our natural resources begin to get low and we have to replace them with something else or use them wisely. Complete each sentence as completely as you can.

1. To save gas we can _____
2. To conserve electricity we can _____
3. To save paper we can _____
4. To lower our utility bills we can _____
5. To create less waste we can _____



**Source:** Nebraska Energy Office

## Student Worksheet

**Source:** Nebraska Energy Office

# Energy Walk in the School

1. Which rooms did we visit?

2. Where did we find energy used in each room?



Source: Nebraska Energy Office

PEOPLE

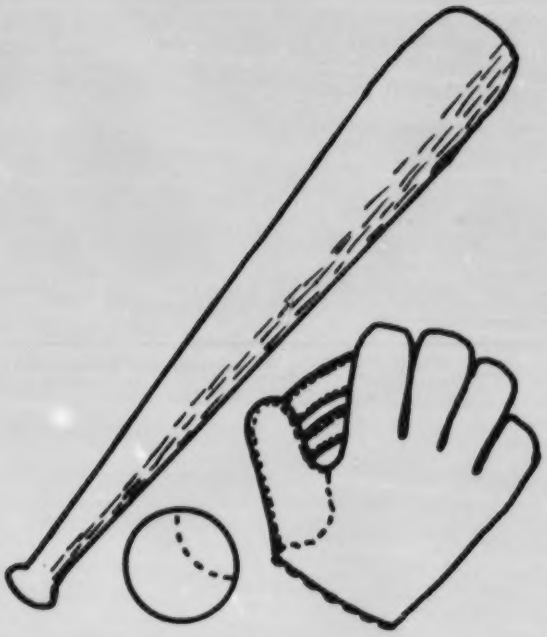
USE

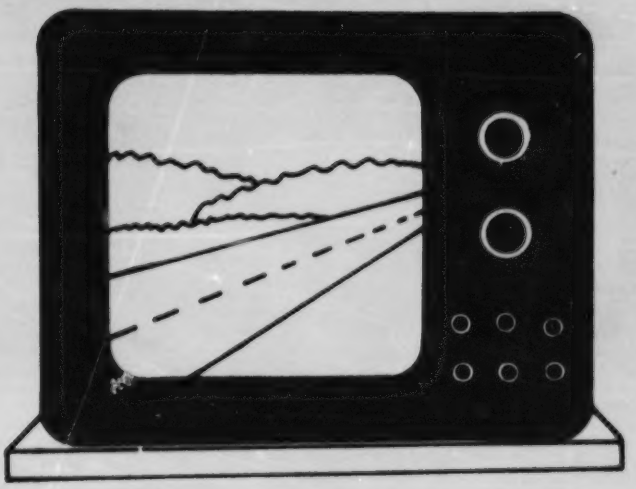
***Energy***

EVERYWHERE

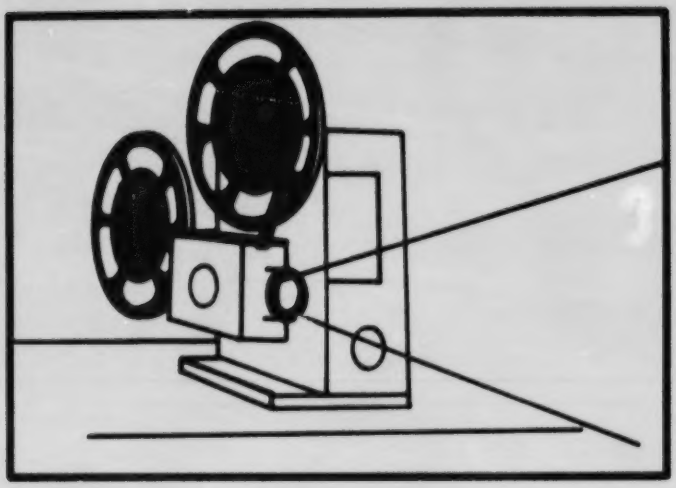
**Source:** Nebraska Energy Office

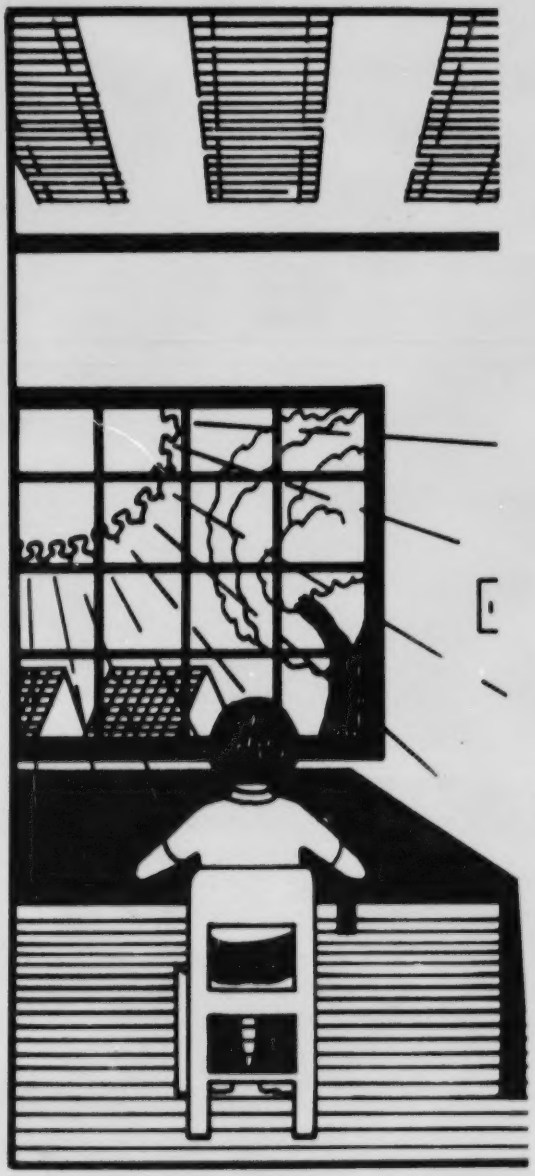
HOME



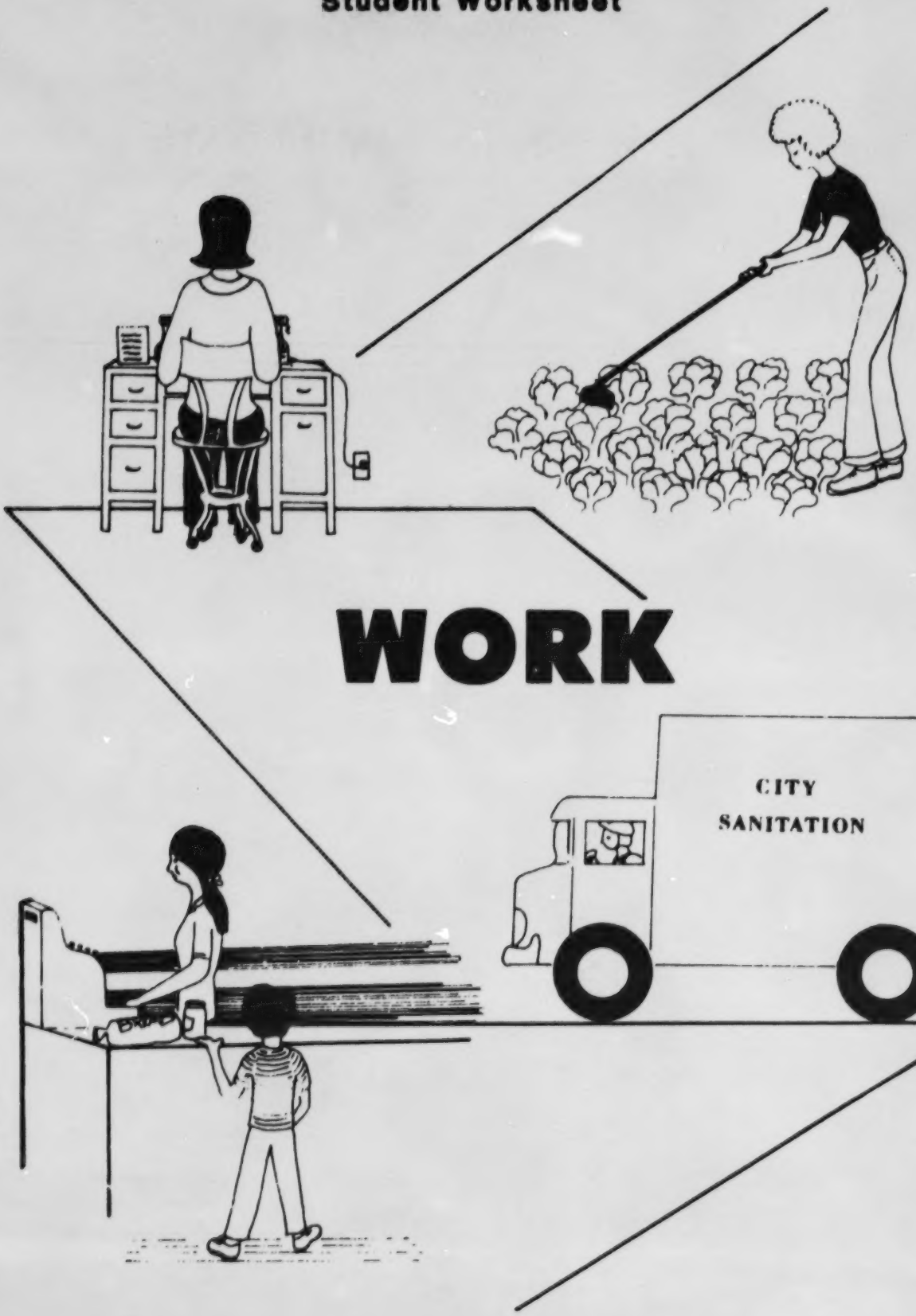


PLAY





# SCHOOL


WORK
CITY
SANITATION

Student Worksheet

# ENERGY IN MY HOME

The different ways I use energy in my home.

What I use the most.

What I use the least.



Source: Nebraska Energy Office

**Student Worksheet**

# ENERGY PUZZLE

| E | L | E | C | T | R | I | C | I | T | Y |
|---|---|---|---|---|---|---|---|---|---|---|
| Q | E | L | E | C | T | R | I | C | L | F |
| P | D | D | S | F | G | O | N | A | C | U |
| S | B | U | O | U | Y | A | C | R | L | R |
| X | T | E | L | E | V | I | S | I | O | N |
| W | C | O | D | L | I | B | F | H | C | A |
| I | O | F | V | U | M | K | O | R | K | C |
| N | R | B | M | E | S | H | O | E | S | E |
| D | N | O | I | L | A | Z | D | Q | I | V |
| M | W | Z | L | C | L | O | T | H | E | S |
| I | G | A | K | N | Y | L | O | N | S | B |
| L | A | J | T | F | U | C | A | N | D | Y |
| L | H | D | X | E | W | Y | L | O | P | A |
| H | O | U | S | E | R | T | Z | E | S | W |

Find these words in the puzzle and circle them.

- stove
- house
- electricity
- television
- clothes
- car
- furnace
- bed
- bicycle
- food
- clock
- nylons
- shoes
- windmill
- water
- electric
- fuel
- gas
- oil
- candy
- milk
- corn

## WANTS NEEDS ENERGY

**Source:** Nebraska Energy Office

Lesson #4

**CATEGORY:** Conservation

**ENERGY TYPE:** Petroleum and Electricity

**TITLE:** We Depend on Oil and Electricity

**GRADE LEVEL:** K-3

**SUBJECT AREA:**
Math
Reading

**TIME NEEDED:** Three 30-minute periods

**MATERIALS:**
Magazines to cut up
Bowl containing pebbles and hard candy
Die (one of a pair of dice)
Pencils

**OBJECTIVES:**

1. The students will discover through a traffic survey how much people depend on gasoline.

2. The students will be able to distinguish between good and services and will understand how we use oil and electricity.

3. The students will understand that energy from oil is nonrenewable and therefore it is important to conserve oil.

4. The students will form attitudes regarding the value of energy as they examine their own use of it.

**TASK ANALYSIS:**

Students should understand the meaning of the terms goods, services, conserve, nonrenewable; know the terms used on the Save Energy Game board including move ahead, move back, take another turn, start and finish; and be able to count up to four for the energy game and up to twenty for the traffic survey.

**PROCEDURE:**

1. Preparation
   Duplicate Student Worksheets 4.5-4.9.
   Tape several sets of Save Energy Game board together so that students may play the game in small groups. Teacher may use paper markers shown on Student Worksheet 4.9 or other markers.
   Assemble other materials listed above.

2. Steps in Lesson

   Objective #1: The students will discover through a traffic survey how much people depend on gasoline.

   a. Locate a busy intersection and with Student Worksheet 4.5 (Traffic Survey) and pencils in hand, chart the number and kinds of traffic. Also have students record the time. This could be done at two

different time periods. When back in the classroom, compare the survey sheets. Then, using Student Worksheet 4.6, have each student make a bar graph based on the data collected.

b. Discuss how much gasoline is needed for so many vehicles. Ask students to think of ways traffic might be decreased so that not so much gasoline is required (car pools, mass transportation, busing, etc.) Be sure to stress that people do not have to stay home to conserve; they just have to plan ahead so that they can share rides with other people.

Objective #2: The students will be able to distinguish between goods and services and will understand how we use oil and electricity.

a. If students are unfamiliar with the terms "goods" and "services", introduce them.

b. Ask the children to bring in pictures or cut from magazines and/or draw pictures of things such as houses, automobiles, boats, refrigerators, TV sets--things they believe they would like to own or have available for their use when they are adults. These are goods.

c. Ask students to find other pictures of services that we depend on performed by other people (delivering the mail, putting out a fire, repairing cars).

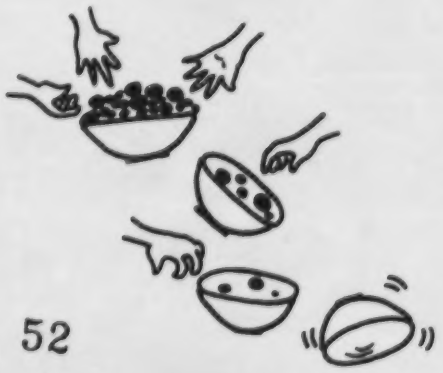
d. Assemble the pictures and drawings in a large collage, divided by goods on one side and services on the other.

e. Discuss the extent to which their "good life" depends on oil and electricity. (Rural route carrier must have gasoline; mechanic needs oil and electricity to run machines; fireman needs gasoline and oil to keep his/her fire truck running.)

Objective #3: The students will understand that energy from oil is nonrenewable and therefore it is important to conserve oil.

Coal, oil and natural gas are commonly called fossil fuels because they were formed from the fossil remains of ancient plants and animals over millions of years. Fossil fuels must be burned before energy can be released. Once burned they are gone. This energy is nonrenewable.
Since oil is considered nonrenewable, students should understand why it should be used carefully and not wasted. This is conservation.

a. Demonstrate the energy problem using a bowl containing pebbles and pieces of candy. Tell the students that the candy represents energy like oil, coal and natural gas. Ask what happens when they use up the energy. Let them eat some of the candy. They will begin to dig for more just as we are now digging for more oil.



b. Have students suggest ways to conserve energy such as gasoline and electricity. Make a bulletin board using drawings, cartoons and stories students make up about saving energy.

c. (optional) Although water is a renewable resource, a good way to show students the meaning of "scarcity" and the need to conserve is to tell them that drinking water has suddenly become scarce. Ration drinks to three short ones a day. (Teacher might count while they drink or get a student to count five seconds and make them stop.) Ask students ways they could get more water if they needed it. Allow them to use their imaginations.

Objective #4: The students will form attitudes regarding the value of energy as they examine their own use of it.

Values Clarification Approach

Source: Sidney Simon, Values Clarification. Hart Publishing Company, Inc.: New York. 1978.

"Valuing," according to Louis Raths, is composed of seven subprocesses:

**PRIZING** one's beliefs and behaviors
1. prizing and cherishing
2. publicly affirming, when appropriate

**CHOOSING** one's beliefs and behaviors
3. choosing from alternatives
4. choosing after consideration of consequences
5. choosing freely

**ACTING** on one's beliefs
6. acting
7. acting with a pattern, consistency and repetition

Thus, the value-clarification approach does not aim to instill any particular set of values. Rather the goal of the approach is to help students utilize the above seven processes of valuing in their own lives; to apply these valuing processes to already formed beliefs and behavior patterns and to those still emerging.

a. Let students divide into groups of four or five and play the Save Energy Game (Student Worksheets 4.7-4.9) using gameboards and markers teacher has provided. This allows for review of energy terms discussed and provides an opportunity for students to think about the things which have been discussed in the lesson.

b. Voting--Values Clarification Activity
The teacher uses the following questions, or similar ones, to help students begin the process of making value decisions. The students respond to each question by raising or not raising their hands. Discuss, if the class seems receptive.

How many of you. . .
---have more than five toys that have a motor or run on batteries?
---like to watch TV in your spare time?
---help turn off lights at home when not in use?
---helped your parents make a list of ways you could conserve energy at home?
---walked more than you rode in the car this week?

3. Evaluation

Ask students to answer the following questions orally:

Name two energy sources that we depend on to keep our cars and trucks moving and to keep most of our home appliances running. (oil and electricity)

Explain what I mean when I say that oil is nonrenewable. (Once it has been used to produce energy, it cannot be used again.)

True or False. I can use all the toys and appliances I want because electricity is cheap and there is plenty of it. (False. The nonrenewable fuels currently being used to make electricity are becoming scarce and more expensive.)

If I leave the light on when I am out of the room, am I conserving or wasting energy? (wasting it) How can I conserve it? (turn off the light)

Can you name some household tools and machines which do not use electricity? (examples: hammer, hand-crank ice cream freezer, manual can opener, clothes line, knife)

4. Suggested Reading

**TIPS FOR ENERGY SAVERS:** Offers practical and simple ways to save energy in the kitchen, workshop, garden and car; includes energy saving considerations when buying appliances and other household merchandise. 1978. 46 pages. Available from Energy Conservation Now, Pueblo, Colorado 81009.

**ENERGY, A GROWING NATIONAL PROBLEM:** Illustrated, 16-page report on our national energy problem and what can be done about it. Glossary of energy terms. Single copy free; additional, 20 cents each; 50 or more, 16 cents each. Available from National Wildlife Federation, 1416 Sixteenth Street, NW, Washington D.C. 20036.

The following curriculum materials are available free in single copies. Bulk quantities sent only to teachers, librarians or energy information centers. Write to: U.S. Department of Energy--Technical Information Center, P.O. Box 62, Oak Ridge, TN 37830.

**COMMUNITY WORKERS AND THE ENERGY THEY USE** (grade 2). There are four units in this packet; in "What is Energy?" students explore the energy forms of light, heat, motion and conservation. In "Community Workers Who Work Directly with the Sources of Energy" students look at the farmer, grocer, oil man, gasoline station attendant, and others. 1978. 80 pages.

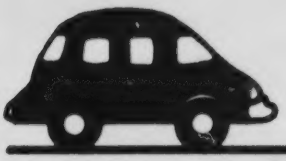
**ENERGY AND TRANSPORTATION** (grade 3). Using classification activities, picture studies and other development approaches, students learn about transportation in the neighborhood, community and nation with the main focus on energy use in the automobile. 1978. 80 pages.

Student Worksheet

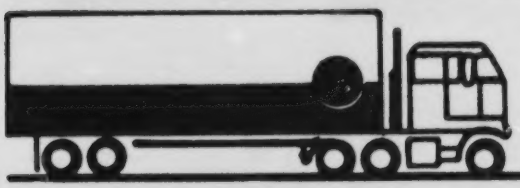
# TRAFFIC SURVEY

Name _____

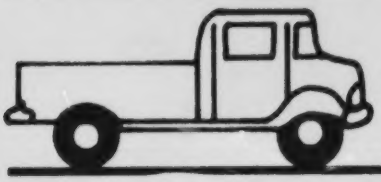
Time of Day _____ How Many?



Cars _____



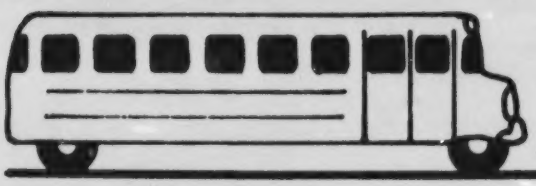
Trucks _____



Pickups _____

Bicycles _____

Motorcycles _____



Buses _____

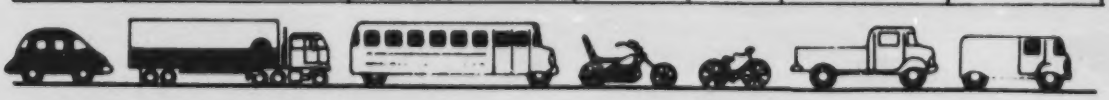
Vans _____

**Source:** Nebraska Energy Office

Student Worksheet

# TRAFFIC SURVEY COUNT

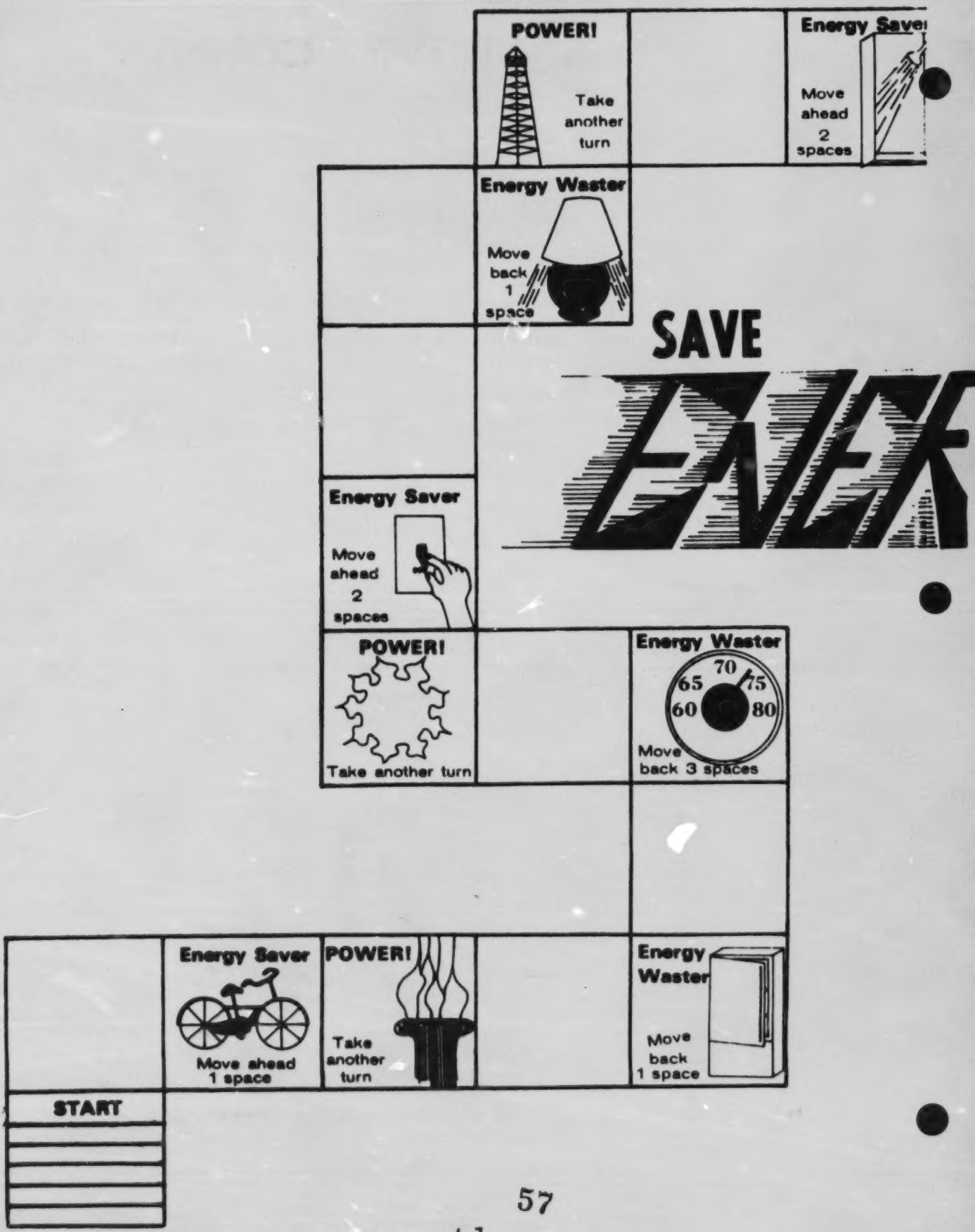
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0



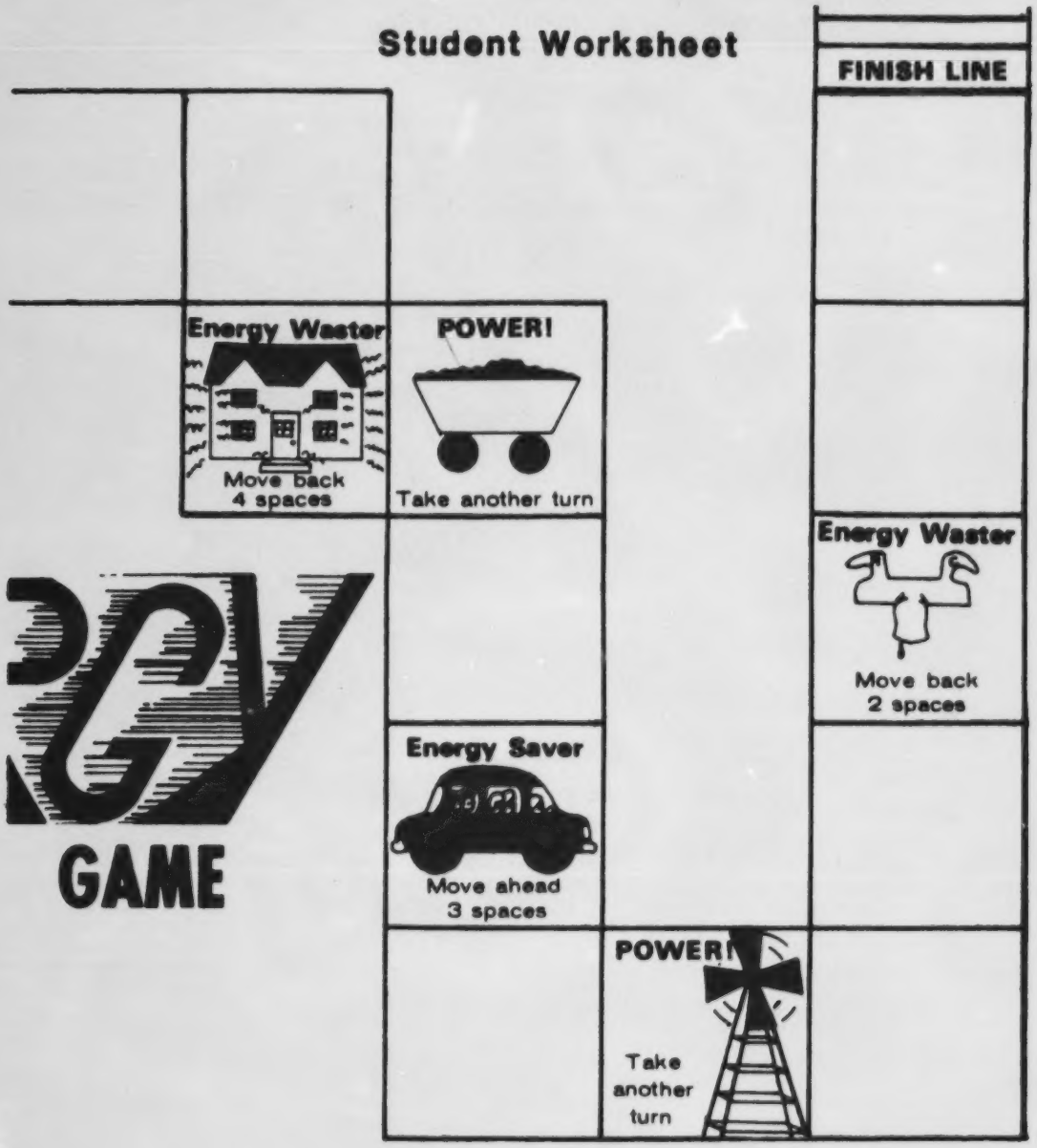
Cars Trucks Buses Cycles Bikes Pickups Vans

**Source:** Nebraska Energy Office

## Student Worksheet



## Student Worksheet




# GAME

**Directions**

1. Each player selects a marker.
2. Each player rolls the die and the high number begins the game.
3. The first player rolls the die and moves the number of spaces indicated.
4. Follow directions written on the space you land on.
5. Each player takes a turn in order until one reaches the finish line.

**Source:** Nebraska Energy Office

# SAVE ENERGY GAME

## Player Pieces

## Cut out and put on cardboard

**Four player pieces are included, however, more can play if you wish to devise pieces.**

**Use a die for determining number of spaces to be moved.**

## LESSON #5

**CATEGORY:** Sources

**ENERGY TYPE:** Electricity

**TITLE:** Electricity: There's a Trick to It

**GRADE LEVEL:** 3

**SUBJECT AREA:**
Language Arts
Science
Social Studies
Math

**TIME NEEDED:** Two to five periods

**MATERIALS:**
Camera
Some plastic scrub buckets
Coffee can
Some tin snips
Dowels (2cm x 6cm, or use straightened coat hanger)
Awl or other sharp tool
Hammer
Wire screening
Blue crayons
Can of sterno (or other suitable flame source) Caution: Read warning label!

**OBJECTIVES:**

1. The students will be able to list several sources of electrical energy.
2. The students will be able to describe in a drawing the network of energy --from the resource for producing electrical energy, through the energy changes, to the consumer who uses it.

**TASK ANALYSIS:**

The students should be able to work a crossword puzzle; and be able to locate items on a map.

**PROCEDURE:**

1. Preparation
   Read Teacher Background Information (5.6-5.8).
   Duplicate Student Worksheets 5.9-5.18.
   Gather materials listed above.
   Determine if class may take a field trip to a power plant.

2. Steps in Lesson

   Objective #1: The students will be able to list several sources of electrical energy.

   Objective #2: The students will be able to describe in a drawing the network of energy--from the resources for producing electrical energy, through the energy changes, to the consumer who uses it.

a. To introduce the lesson, use this analogy:

Ask students: Have you ever seen a magician pull a rabbit out of an (apparently) empty hat? Sure you have. It was magic, right? Wrong! It was just a trick. There was a rabbit there all along and it took years of study and practice for the magician to learn how to fool us. Electricity is something like a magician's trick. It seems like magic, but there's a trick to it. When you plug in a TV set and suddenly a picture appears on the screen, have you ever wondered where the electricity that makes it possible comes from? What makes it? What problems does making it create for people and animals?

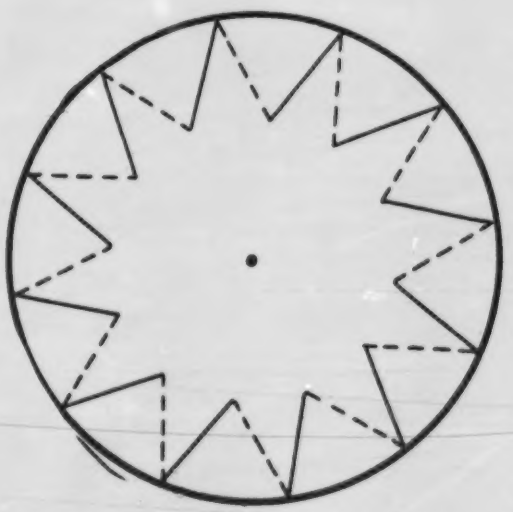
It is easy to see the advantages of electricity. It makes everything easier. Just look around. There are air conditioners, stereos, toasters, can openers, washers, dryer, even toothbrushes that work because of electricity. Can you name some other items you have that need electricity to work?

In this lesson, we will learn that in using electricity, we are often using up primary energy sources like coal, oil and natural gas which must be burned in order to produce electricity, a secondary source. We will also see how electricity is produced from falling water, a renewable source of energy.

b. Distribute copies of Worksheet 5.9, Electricity from Falling Water. Have a student read the sheet aloud and then have the class discuss the information.

c. Make turbine wheels by following these instructions:
Punch a hole in the middle of a coffee can lid using an awl and hammer. Cut the lid with tinsnips on the solid lines. Fold on the dotted line. Place axle (dowel or coat hanger) through hole in middle. See below.

d. Fill some buckets with water and take class outside with their turbines. Have some students pour water over the wheels. Then ask the following questions:
Does the wheel turn faster if you pour the water faster?
Does the wheel turn faster if there is more water poured?
What happens when there is only a trickle of water poured?
Does the wheel turn faster when the water is poured from a bucket high above it or from one just above it?
How does this demonstration help us understand the picture we just looked at?
Can anyone explain the drawing now?



TURBINE WHEEL PATTERN

## Electricity from Fossil Fuels

e. Distribute copies of Student Worksheet 5.10 and discuss.

f. To illustrate the force of steam, place a large tin can with both ends removed over a can of sterno. Set a piece of wire screening or non-flammable substitute over the top end of the can. Then place a small aluminum can, such as the kind sandwich spreads come in, on the wire screeen. Fill the can half full of water and place a piece of cardboard on top of the can.

Light the sterno and wait till the water boils. (While they are waiting, students might like to predict what will happen. Look for predictions that the steam will move the cardboard. If no students suggest this, tell them to watch closely and to look for movement.) When the cardboard begins to move, ask: What caused the cardboard to move? How is this like the turbine wheel moving?

## Electricity from Uranium

g. Distribute copies of Student Worksheet 5.11 and discuss.

h. Explain that humans are able to split the nuclei of atoms, and have applied this to the production of electricity.

i. Distribute copies of Student Worksheets 5.12 and 5.13. Have students complete the questions working in small groups. Later each group can present its findings to the class.

Answers to Student Worksheet 5.13:

Part A

1. Yes
2. Yes
3. Yes
4. No
5. Maybe
6. Yes
7. Yes

Part B (oil, natural gas and coal)

Part C (Network should show these components: energy source--coal, oil, gas, uranium, hydroelectric, in some cases geothermal; boiler--except for water power; turbine; generator transformer; power lines.)

## Reading a Circle Graph

j. Distribute copies of Student Worksheets 5.14 and 5.15. Worksheet 5.14 shows major sources of electricity in Arkansas. Have students make a trial graph using the number of boys and girls in the class. For example, the total number of all students would equal 100 per cent. What percentage would, say 14 boys equal? (46 per cent) Sixteen girls? (54 per cent) Draw a circle on the chalkboard. Have a student divide the circle in half. Ask students to tell what per cent is represented by each half. (50 per cent) Have someone estimate where the boys' side should be divided to show 46 per cent. Shade that part in. Ask if the remaining portion is greater than 50 per cent. Is it close to 54 per cent? Write <u>Boys</u> in the shaded portion, <u>Girls</u> in the unshaded portion.

k. Now discuss the circle graph on Student Worksheet 5.14. Help students complete the questions which accompany the graph (Student Worksheet 5.15). Sum up by telling students that the fuels on the graph are the major sources used in Arkansas to produce electricity. Using figure 1 on Teacher Background Information sheet 5.6, draw a circle graph on the chalkboard showing major sources of electricity in the United States. Have students compare with Arkansas graph.

Answer Key: Student Worksheets 5.14, 5.15.

1. What does the graph show? [Fuels used to produce electricity and how much of each is used (relatively)]
2. How many kinds of fuel are on the graph? (Five)
3. Which fuel is used the most? (Oil)
4. Which fuel is used the least? (Natural gas)
5. Write the name of the fuel or the amount used in the chart.

| (Nuclear) | Oil | (Water Power) | Natural gas | Coal |
|---|---|---|---|---|
| 23% | (28%) | 20% | (15%) | (14%) |

6. What is the total amount of fuel used? Add the percentages. (23 + 28 + 20 + 15 + 14 = 100)

3. Evaluation

a. Distribute copies of the Network Word Puzzle (Student Worksheet 5.16). Use this as a tool for measuring student understanding. Answer Key found below.

b. Use the drawing done by students on Part C of Student Worksheet 5.13 to see if they understand how electricity travels from source to end use.

Answer Key: Network Word Puzzle

Across
2. A black, solid fossil fuel. (coal)
3. Air-like fuel. (gas)
4. Source of energy in hydroelectric plants. (water)
5. Another name for atomic. (nuclear)
7. Fossil fuels may be found in the (ground).
11. Used by people to produce heat and light. (electricity)
12. An (atom) is split in a nuclear reactor.
13. A wheel that turns a generator through use of water or steam. (turbine)
15. A (generator) produces electricity by moving wires through a magnetic field.

Down
1. Coal, oil and natural gas are (fossil fuels).
4. Electricity flows through (wires) to get to your home.
6. The material used in nuclear reactors is (uranium).
8. Boiling water makes (steam).
9. A black, liquid fossil fuel. (oil)

10. The production of electricity by running water. (hydro-electric)
13. A turbine (turns) the generator.
14. Sound of the water falling near the hydroelectric plant. (roar)

4. Follow-Up Activities

a. Take the class to see a power plant.

b. Show a film about water power. (Most electric utility companies have such films.)

c. Duplicate copies of the letter on Student Worksheet 5.17 to send home to parents, and ask students to see how their families rate on energy conservation by checking "yes" or "no" on Student Worksheet 5.18.

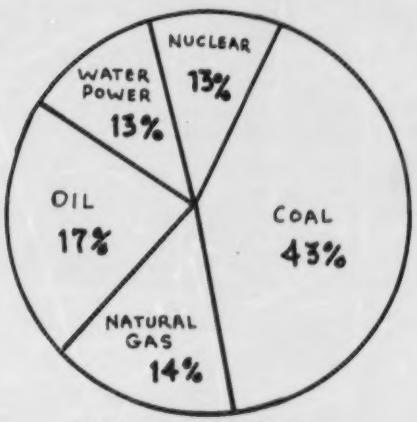
d. Do the experiment suggested on pages 5.19 and 5.20. You may want to duplicate copies of the worksheets for students to take home but it is not necessary.

Source:

Paul L. Butt. Arkansas Energy: A Look at the Alternatives. Arkansas Ecology Center: Little Rock. 1979.

The circle graph shown in Figure 1 below gives an idea of the fuels used nationwide to produce electricity. Arkansas' fuel mix (Figure 2) for generating electricity is atypical in comparison.

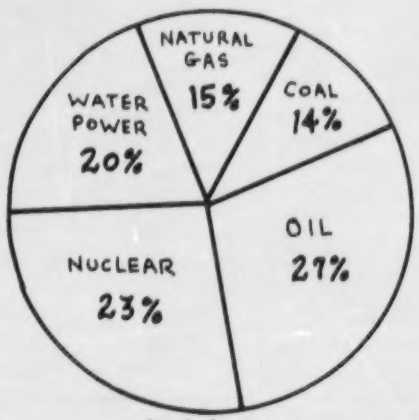
Major sources of Electricity




In the United States

Figure 1

1979




In Arkansas

SOURCE: Arkansas Energy Office Figure 2

As you can see, Arkansas relies heavily on oil and nuclear energy to produce its electricity, whereas the rest of the nation uses coal as its major primary source. As we move into the 1980's, Arkansas will use more and more coal (including lignite). But since coal is the most polluting fossil fuel, environmental problems are bound to increase.

Electric power plants are one of the major sources of air pollution. They contribute about 25 per cent of particulates (soot), 25 per cent of nitrogen oxides and 55 per cent of sulfur oxides emissions.

Many power plants have moved to the countryside because of safety and pollution considerations concerning the cities. But this has not helped the environment. Power plants take up large masses of land and also discharge large quantities of wasted heat into nearby waterways.

What is so harmful about heating the water? As the temperature of water increases, the bio-chemical processes of aquatic life speed up and their need for oxygen increases. However, the heated water can hold less oxygen. Thus the water is quickly depleted of the oxygen needed to support life and to cleanse itself.

On page 5.8 is a map showing the Arkansas counties and their use of electricity by per cent of expected use. If your county is heavily shaded, perhaps you and your class could make a project of finding out why it uses more electricity than is expected for its population size.

This lesson addresses the topic of sources of electrical energy. Through simple diagrams and activities, students will learn about the production of electricity from falling water, from fossil fuels and from uranium.

## Nuclear Energy: A Primer

So far as we know, no energy is being annihilated. Nor is it being created. But the various forms of energy are being transformed constantly: light to heat, heat to light, electrical to light and heat, light and heat to electrical, atomic to heat, and so on. The universe is filled with energy.

At one time, it was thought that the atom was the smallest indivisible particle of matter. And an atom is mighty small--so small that there are six sextillion (that's a 6 with 21 zeros) of them in a drop of water.

What does an atom really look like? No one knows. The answer to this question changes over the years due to scientific discoveries about the atom.

For many years, people thought the atom was like a small copy of the solar system (see drawing A below). In the center was a heavy object, called the nucleus. The nucleus was the "sun" of the atom. Light objects revolved around the nucleus. They were called electrons.

Scientists today say this view is not quite right. An atom does have a nucleus and electrons. But the electrons do not always circle the nucleus. Their paths are always changing. (See drawings B and C.)

The path of an electron may form a figure eight. Or an electron may travel in long loops.

The nucleus has most of an atom's energy. We often call the energy stored in the nucleus, atomic energy. A more accurate name is nuclear energy. Some of this energy is released when the nucleus is bombarded and broken apart.

The energy which holds the particles of a nucleus together is very great. Yet some elements, such as radium and uranium, give off part of this energy naturally.

Scientists reasoned that if the nuclei of these elements were disturbed even more, much greater amounts of energy would be released. To find a way to break up the nucleus of an atom took many years and the best efforts of top-notch scientists.

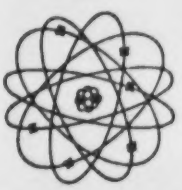
One way they finally found was to fire atomic particles from certain atoms at great speeds into other atoms. To do this, they used a machine called a cyclotron. We sometimes call it an atom smasher.

With a cyclotron,scientists made an important discovery. They put a heavy metal, uranium, in a cyclotron. Then they bombarded it with atomic particles. What happened? Atoms in the uranium split, and energy was released. This process is called atomic fission. Fission means splitting apart.

A

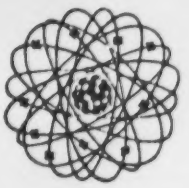
HELIUM

B

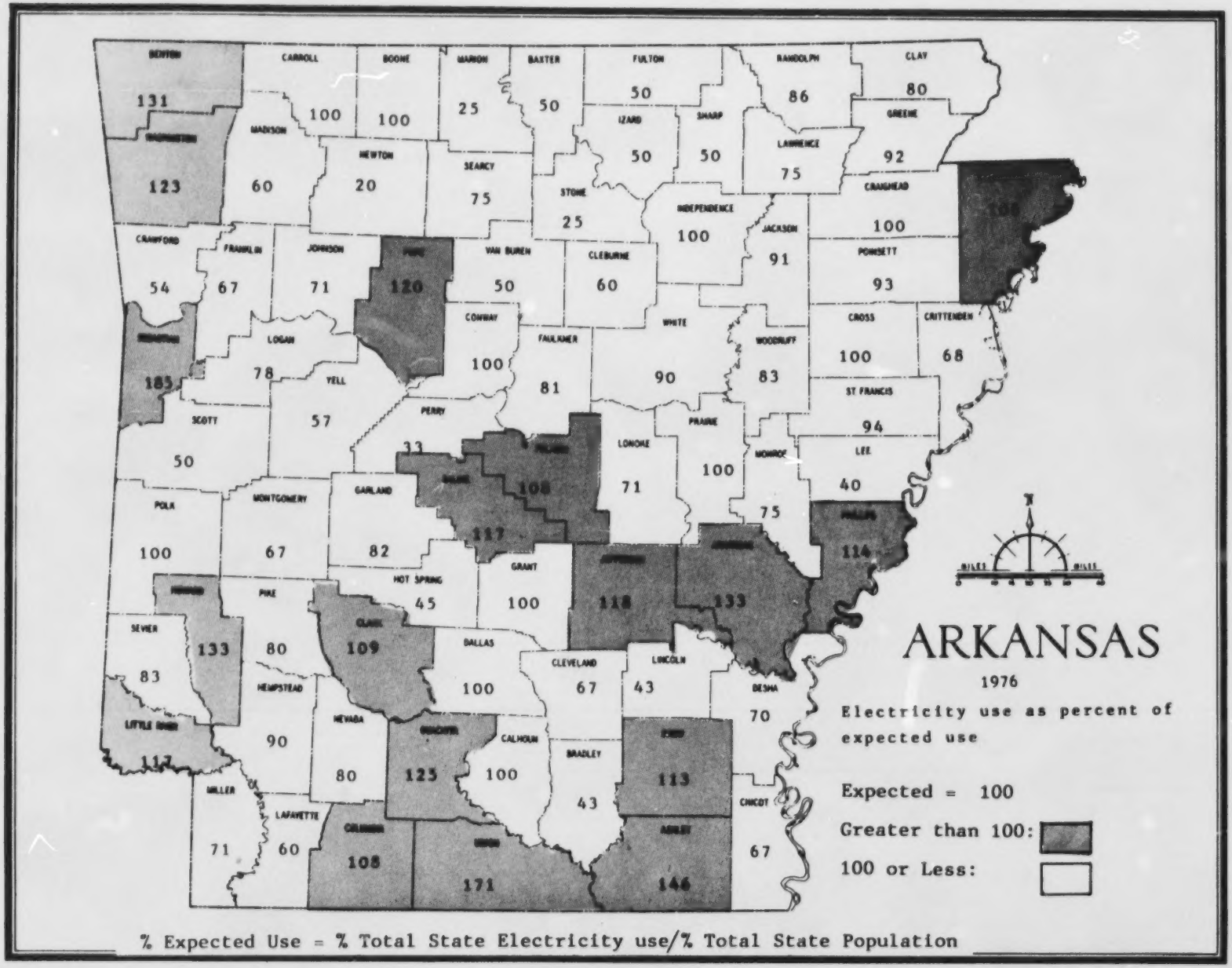


CARBON

C



URANIUM

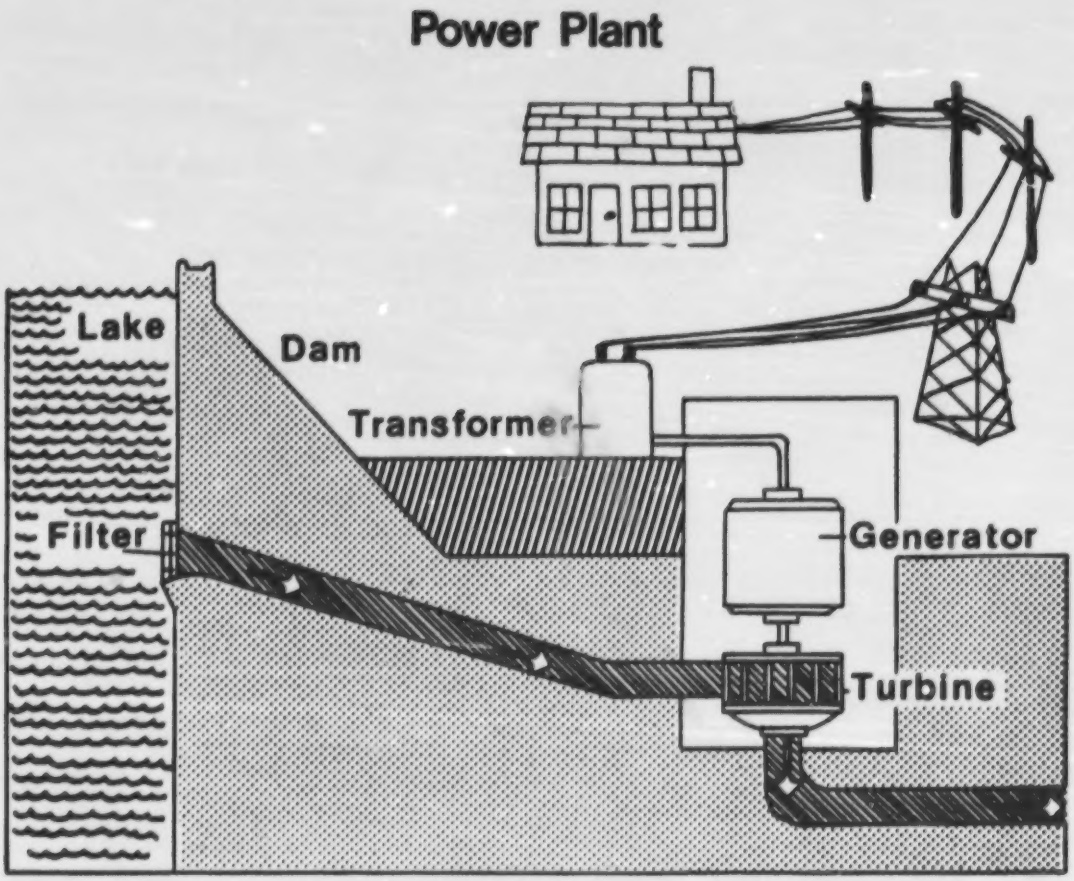



5.8

Data Sources: Brookhaven National Laboratory; U.S. Bureau of the Census

## Student Worksheet

Electricity from Falling Water



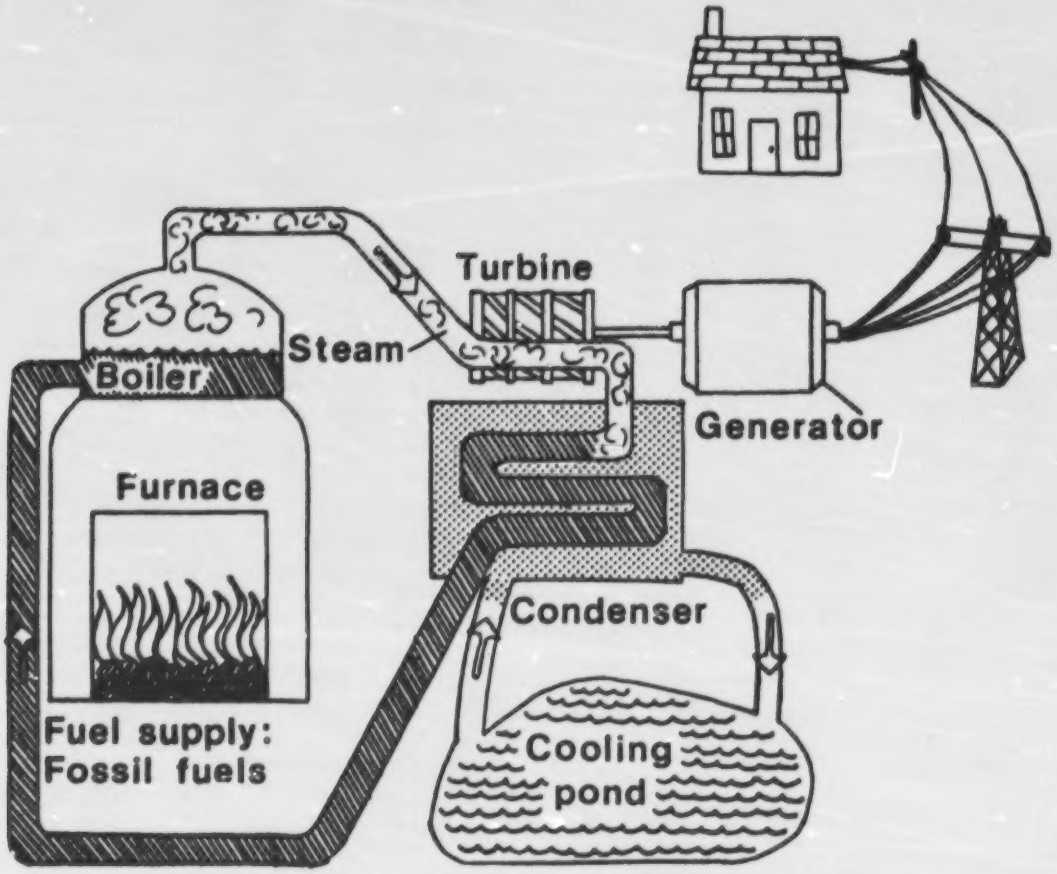

Hydroelectric power is provided by the motion of falling water. When water which has been trapped in a lake behind a dam is released as needed, it can be made to flow through the turbines which activate generators that make electricity.



**Source:** United States Department of Energy

## Student Worksheet

Electric Power from Fossil Fuels



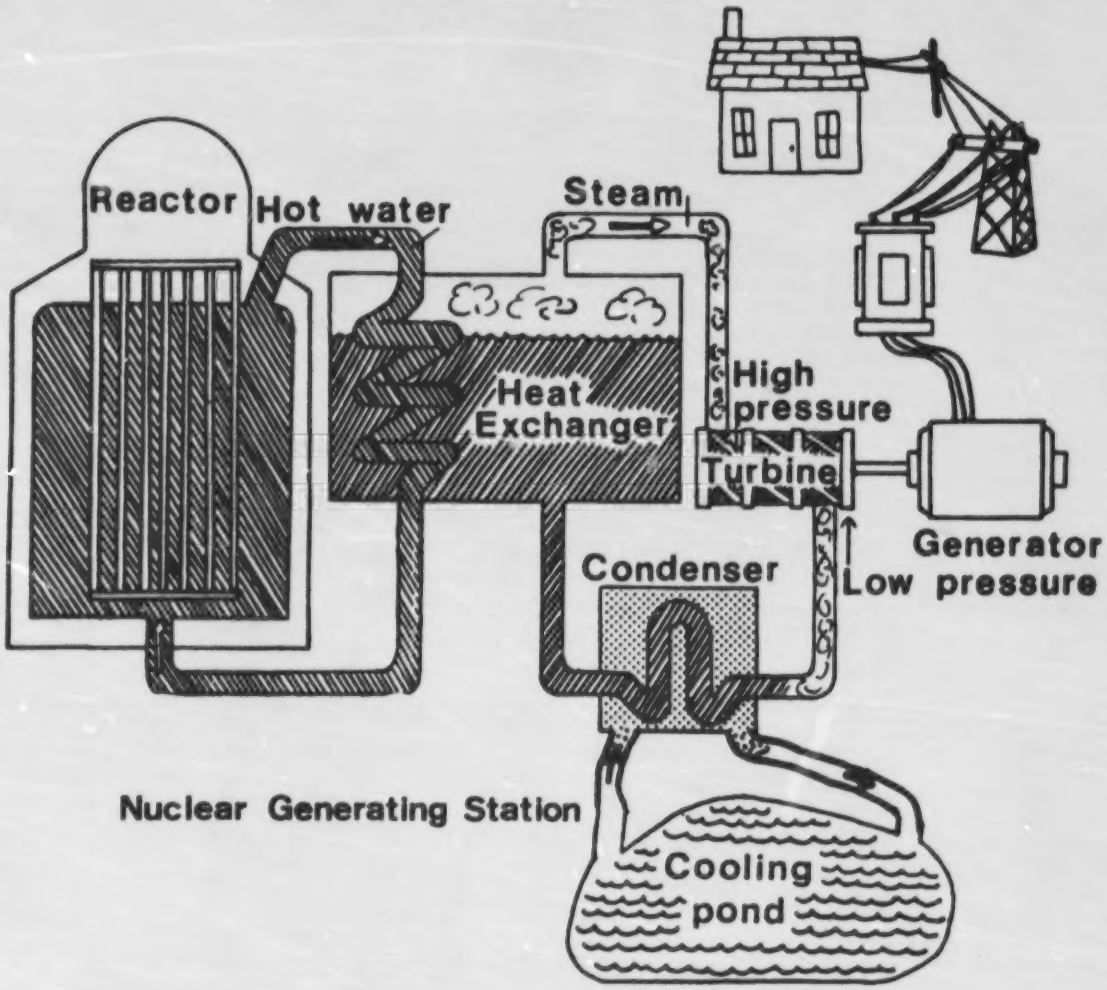

Fossil fuels (oil, gas, coal) produce electrical power by burning it in a furnace to heat boilers that make steam. The steam turns a wheel called a turbine. The turbine drives a generator that makes electricity.



**Source:** United States Department of Energy

## Student Worksheet

Electricity from Uranium

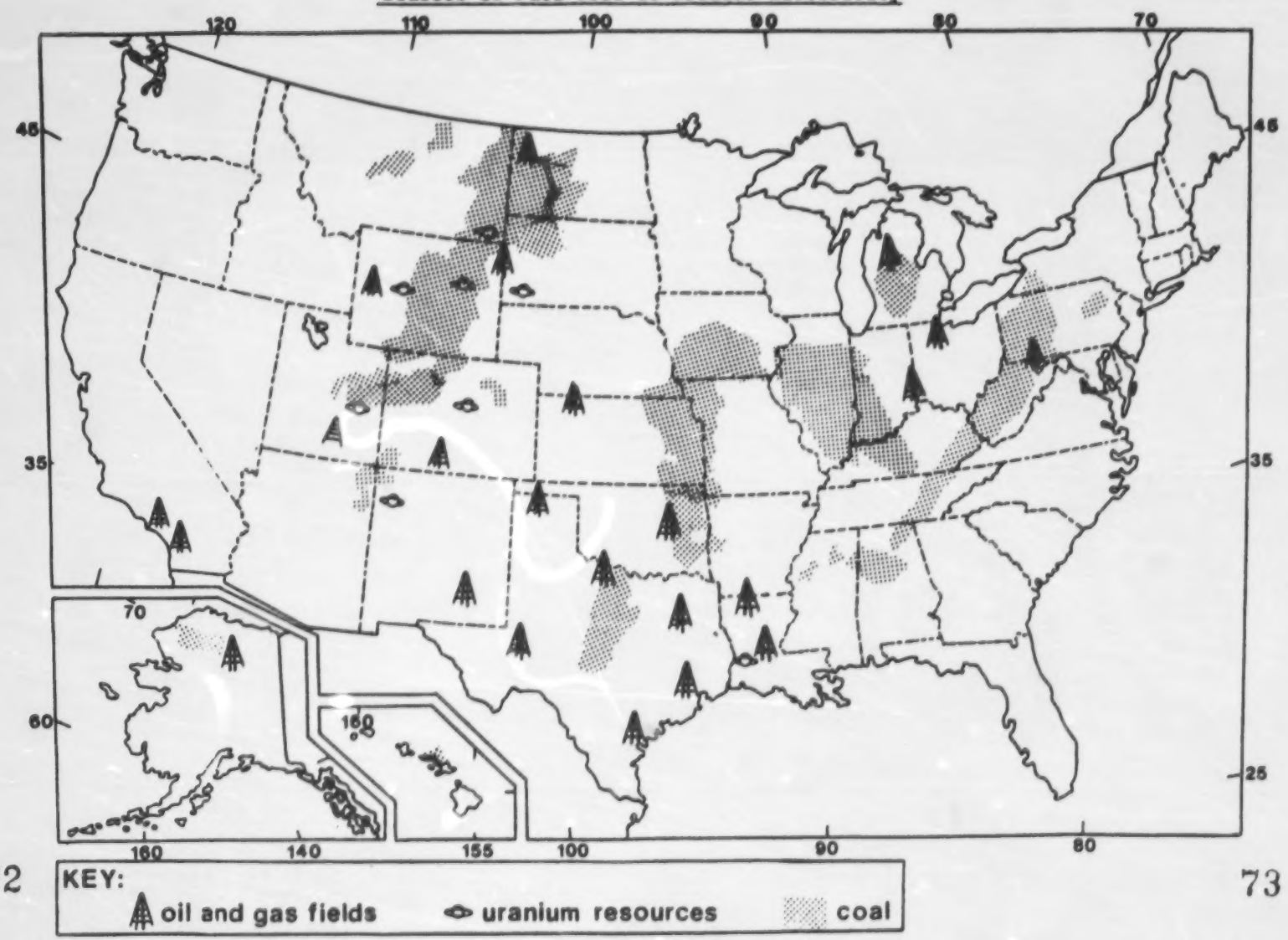



Uranium is used in a nuclear reactor to produce electrical power. The uranium is split and gives off heat which makes steam from water. The steam turns a turbine which drives a generator. The generator makes electricity.



**Source:** United States Department of Energy

## Sources of Fuel Used to Produce Electricity




**Source:** United States Department of Energy

5.12

# Student Worksheet

Map Study Questions

Study the map, Sources of Fuel Used to Produce Electricity. Answer these questions Yes, No, or Maybe.

Part A

1. Is coal found in the East?

2. Are there oil fields in the West?

3. Are uranium resources found in the Southwest?

4. Do all of the states have natural gas and oil fields?

5. Could a coal miner find work in Arkansas?

6. Are there large coal deposits west of the t of the Mississippi River?

7. Does the Southwest have many oil and natural gas fields?

Part B

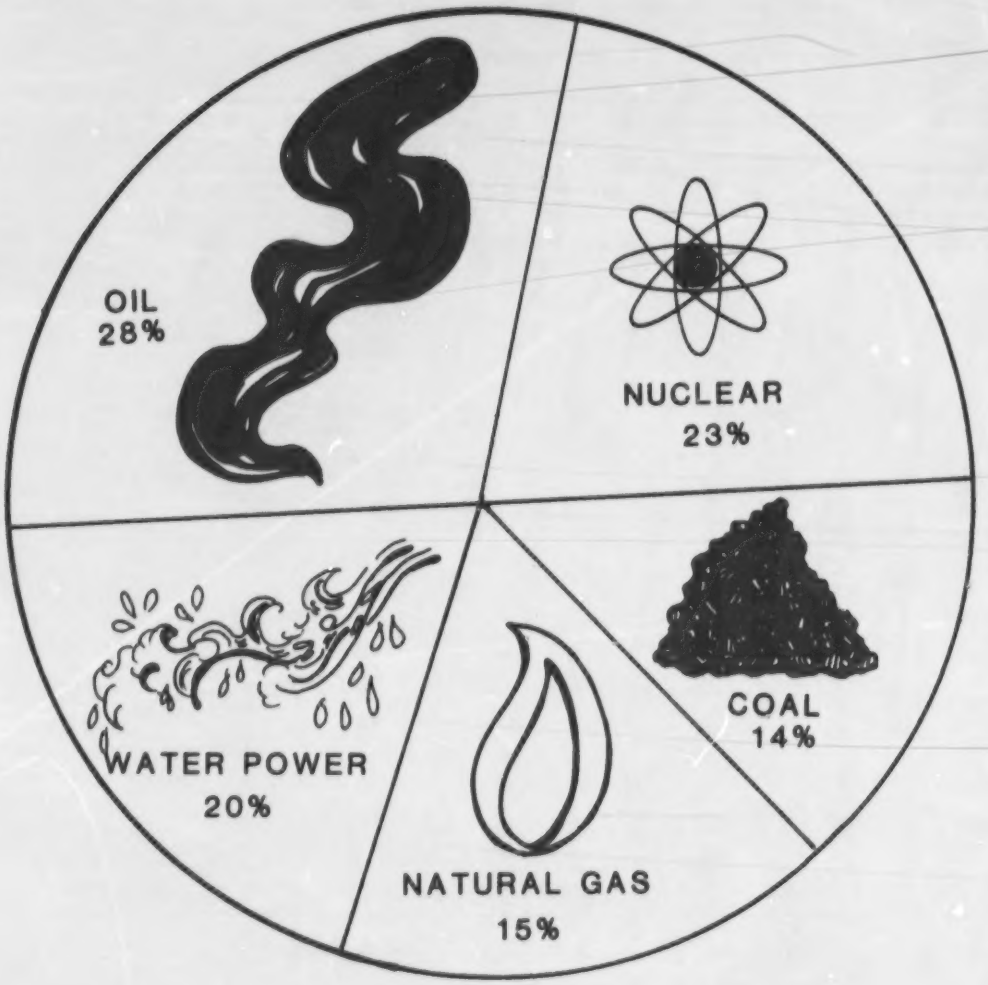
Find Arkansas on the map. Are there any fuel deposits in Arkansas? Name them.

Part C

Draw a network. Start with the source of the energy and get electricity to your home; to a neighbor's home; to a friend's home in another town.

# Student Worksheet

Major Sources of Electricity in Arkansas 1979




Look at the circle graph. Then answer these questions.

1. What does the graph show?

2. How many kinds of fuel are on the graph?



**Source:** Arkansas Department of Energy

# Student Worksheet

Major Sources of Electricity in Arkansas (continued)

3. Which fuel is used the most?

4. Which fuel is used the least?

5. Write the name of the fuel or the amount used in the chart.

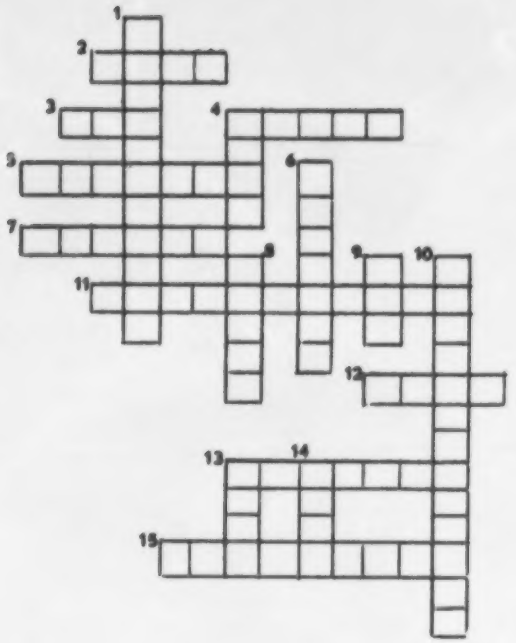
| _____ | Oil | _____ | Natural Gas | Coal |
|---|---|---|---|---|
| 20% | __% | 23% | __% | __% |

6. What is the total amount of fuel used? Add the percentages.

**Source:** Arkansas Department of Energy

# Student Worksheet

## NETWORK WORD PUZZLE



Words to choose from:

coal
electricity
fossil fuels
gas
generator
uranium
hydroelectric
nuclear
oil
turn
steam
turbine
roar
atom
ground
wire
water

**Across**

2. A black, solid fossil fuel.
3. Air-like fuel.
4. Source of energy in hydroelectric plants.
5. Another name for atomic.
7. Fossil fuels may be found in the _____.
11. Used by people to produce heat and light.
12. An _____ is split in a nuclear reactor.
13. A wheel that turns a generator through use of water or steam.
15. A _____ produces electricity by moving wires through a magnetic field.

**Down**

1. Coal, oil and natural gas are _____ _____.
4. Electricity flows through _____s to get to your home.
6. The material used in nuclear reactors is _____.
8. Boiling water makes _____.
9. A black, liquid fossil fuel.
10. The production of electricity by running water.
13. A turbine _____s the generator.
14. Sound of the water falling near the hydroelectric plant.



**Source:** United States Department of Energy

Dear Parents,

The students are busy learning about energy. They are also finding ways to conserve energy. Please use the following questions to begin a family discussion of energy. In this way the students will recognize the connection between what they learn at school and how they live. In the next day or so we will spend time discussing what the families talked about.

Thank you for your help.

1. How do people get energy?

2. Do we plan our meals so we get the most energy from what we eat?

3. What kinds of energy do we have in our home?

4. Where does energy come from?

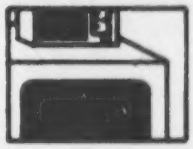
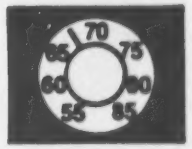
5. What things in our home use the most energy?

6. What are we doing so we are not using too much energy?

7. What else can we do to cut down the amount of energy we use?

## Student Worksheet

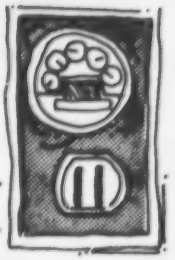
### HOW DOES YOUR FAMILY RATE IN ENERGY CONSERVATION ?

| YES | NO | | |
|---|---|---|---|
| ☐ | ☐ | | Do you combine errands so you can use the car less?<br>Do you walk or ride bike instead of always using the car? |
| ☐ | ☐ | | Do you turn off lights when not needed? |
| ☐ | ☐ | | Do you keep the sun out on hot days? |
| ☐ | ☐ |  | Do you turn off TV, radio and stereo when no one is looking or listening? |
| ☐ | ☐ | | Do you let the sun in on cold days? |
| ☐ | ☐ | | Do you wear warmer clothes when it is cold? |
| ☐ | ☐ |  | Do you keep the thermostat 65-68 degrees in winter and 78 degrees in summer? |
| ☐ | ☐ | | Do you try not to be wasteful?<br>Do you recycle? |

How many times did you mark the "yes"? _____

How many times did you mark the "no"? _____

# HOW MUCH ELECTRICITY DOES YOUR FAMILY USE AT HOME IN 1 DAY?



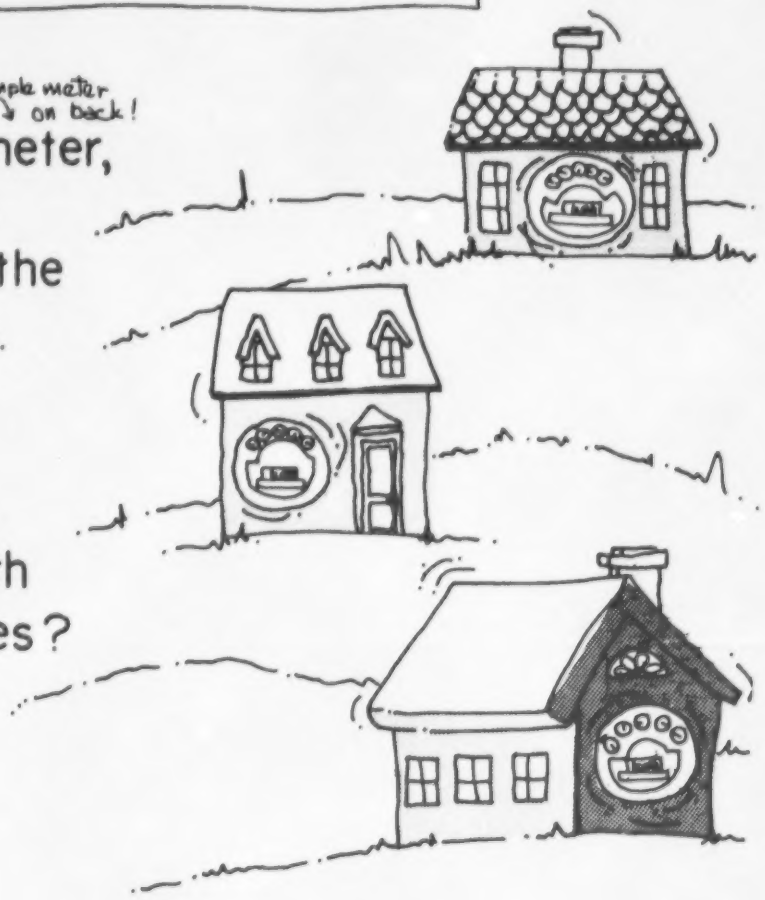
**MATERIALS:**

Kwh = kilowatt hour!

Kwh meter at home
Demonstration kwh meter for teacher

sample meter on back!

Practice reading a meter, then find the one in your home. Record the readings for 2 days. Subtract: how many kilowatt hours did you use? How does your use compare with that of other families?



Call the electric company to see how much 1 kwh costs!

1 kwh = $____

Record electric use for 1 week. How much did one day's electricity cost?

**Source:** United States Department of Energy

HOW TO READ
YOUR
ELECTRIC METER

Read the dials from right to left and copy the numbers in the same order.

When the indicator lies between two numbers, record the number it just passed. (It will always be the smaller number!)

The number above would be recorded like this: 13488 !

> Note: The teacher should have each student make a model meter with movable hands or make one large meter for the whole classroom to practice reading.



**Source:** United States Department of Energy

LESSON #6

**CATEGORY:** Sources

**ENERGY TYPE:** Fossil Fuels

**TITLE:** Yesterday's Fossil Fuels Today's Automobile

**GRADE LEVEL:** K-2

**SUBJECT AREA:**
Science
Art
Physical Education
Language Arts

**TIME NEEDED:** Four 30-minute periods

**MATERIALS:**
Some samples of oil, coal, or coke
Some crackers in a plastic bag
String
Scissors
Crayons
Paste
Blue and black construction paper
Candle
Pie pan
Plaster of Paris
Clay
Vaseline
Sea shell

**OBJECTIVES:**

1. The students will be able to identify three fossil fuels: coal, oil and natural gas.

2. The students will understand the concept of "nonrenewable" energy sources.

3. The students will recognize the many ways we depend on fossil fuels.

4. The students will learn how fossils were made by making their own models.

5. The students will infer that coal is sometimes used for producing electricity.

**TASK ANALYSIS:**
The students should be able to use scissors and paste; recognize the crayon colors black, orange, blue and green; be able to participate in creative dramatics (or role-play) situations.

**PROCEDURE:**

1. Preparation

   Read Teacher Background Information (6.5)
   Duplicate Student Worksheets 6.6-6.11.
   Collect and assemble above listed materials.

2. Steps in Lesson

Objective #1: The students will be able to identify three fossil fuels: coal, oil and natural gas.

a. Distribute copies of Student Worksheet 6.6. Explain to students that coal, oil and natural gas are called "fossil fuels". These fuels were formed long ago before people lived on the earth. At that time the earth may have looked like the picture on the Worksheet.

b. Read the following story to the students:
Long ago these plants and animals lived and died and fell to the ground. More and more of these large trees grew, and they in turn fell to the ground and covered the first ones. (Ask some students to demonstrate how trees became old, died and fell. Then ask more students to act as "trees" falling on top of the first ones. Ask bottom "trees" how it feels under the weights of the others.)

Sometimes the land sank and was covered with water and at times it would rise again. (Ask two more students to demonstrate the land and water.)

Through the ages the materials on top became heavier and heavier and the plants and animals underneath were pressed harder and harder. Gradually they changed into coal, oil and natural gas. This process took millions of years.

Since this all happened before there were people on earth, how do we know about these plants and animals which lived so long ago? Sometimes they leave records. These records are called fossils.

c. Let students examine samples of oil and coal and remind them how long ago these were made. Explain that once they are used or burned to make energy, they are gone forever. We call them "nonrenewable". Ask students to cut out along the heavy black lines on Student Worksheet 6.6. Then they may fold the picture in half to make a card or book. Inside the card have them write: Fossil fuels such as coal, oil and natural gas are nonrenewable. (This may be carried home to parents.)

Objective #2: The students will understand the concept of "nonrenewable" energy sources.

a. In order to help students further understand the meaning of nonrenewable, place two crackers in a plastic bag. Let the class examine the crackers. Then have a number of children eat up the crackers. Look again at the plastic bag. All the crackers are gone. Those two crackers are gone forever. They were nonrenewable. Ask a student to explain how this is like fossil fuels. (When we use them up, they are gone forever, too.)

b. Burn a candle in an aluminum pie pan. Feel the heat energy. Observe the light energy. Once the candle is completely burned down, its energy is gone. Ask students what new word they have learned today to describe this kind of energy. (Nonrenewable)

Objective #3: The students will recognize the many ways we depend upon fossil fuels.

a. Use the pictures showing the kitchen and outdoor picnic scene (Student Worksheet 6.7). Ask students to find things in each of the pictures which give off heat or light. Color these orange. (Save Worksheet for future activity.) Ask students where the heat or light comes from. (Electricity and natural gas) Explain that electricity sometimes uses coal, oil and natural gas, nuclear energy or water for power. The coal, oil and natural gas have to be burned to give off energy.

b. Distribute copies of Student Worksheet 6.8. Ask students to circle things that need gasoline or oil in order to move. (Explain that gasoline is made from oil which comes from the ground. Oil is a fossil fuel.)

Objective #4: The students will learn how fossils were made by making their own models.

Place a layer of modeling clay in the bottom of a box. Grease the top of the clay with vaseline. Press a sea shell into the clay to make a deep impression. Remove the shell and pour molding plaster into the impression. When the plaster hardens, remove the cast and sand the edges. The "fossil" can be used as a paperweight. (Caution: Do not dispose of or rinse out leftover plaster in any drain. It could permanently clog the drain.)

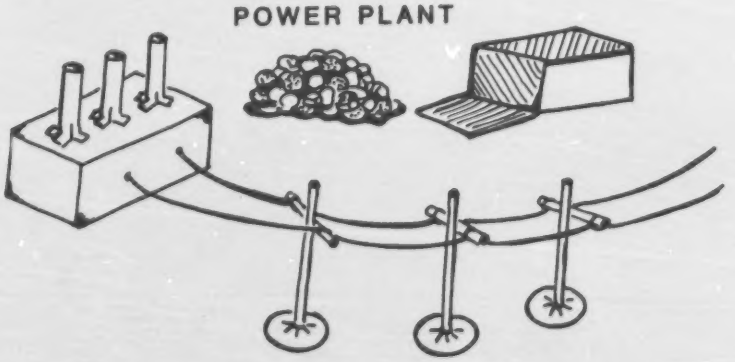
Objective #5: The students will infer that coal is sometimes used for producing electricity.

a. Distribute Student Worksheets 6.9 and 6.10. Have students cut out the parts on 6.9 and begin to fold and paste the tabs to make a power plant with its accompanying power lines. (Teacher can make this simpler or more complex depending on the ability of the class.)

b. Have the class work individually or in small groups. One group might tear small pieces of black paper, wad them up and pile these "pieces of coal" beside the generator to make a coal pile. Others can make a dam to represent water power as a source of energy. (Worksheet 6.10) And the thicker rectangular pieces at the bottom of Worksheet 6.10 can be rolled to make smokestacks. Cut up the dotted lines and bend outward to make tabs to fasten to the roof of the power plant.

The finished power plant should look something like this:

POWER PLANT



3. Evaluation

a. Tell students to think of some of their daily activities. Ask: If there were no coal, natural gas or oil, which activities would you have to stop doing? Have students draw a picture to show which one they would miss the most. Then they can tell about their pictures.

Ask students to put a "C" (or color black) in the corner if coal is needed for the activity.

Ask students to put an "O" (or color orange) in the corner if oil or gasoline is needed for the activity.

Ask them to put a "G" (or color green) if natural gas is needed.

Ask them to put an "E" (or color blue) if electricity is needed.

b. Distribute copies of Student Worksheet 6.11. Point out that each picture has a block in the corner. Have the students identify the form of energy needed to perform each activity pictured using the key at the bottom.

4. Follow-Up Activities

a. Have students make a dinosaur diorama or miniature scene in a shoe box. Make the dinosaurs of modeling clay and the background from construction paper. Use the dioramas as a basis for discussion about the formation of fossil fuels.

b. Turn over an old log. Observe the small animals underneath it and look for evidence of decay of the log itself.

c. Have students write creative stories about what life would be like without electricity or natural gas or gasoline. (Grades 2-3)

TEACHER BACKGROUND INFORMATION

Sources:

Paul L. Butt. Arkansas and Energy: A Look at the Alternatives. Arkansas Ecology Center: Little Rock, AR 1979.

United States Department of Energy. The Energy We Use. United States Department of Energy: Washington D.C. 1980.

Arkansans depend on oil and natural gas for 83 per cent of their energy. A third fossil fuel, coal, has not been a significant part of the Arkansas energy mix in recent years. But with the dwindling national supplies of oil and natural gas, coal will probably become an increasingly important component of the state's fuel mix.

About 99 per cent of the coal mined in Arkansas has come from Franklin, Johnson, Logan, Pope, Scott and Sebastian counties. Most of the coal reserves are in these same six counties and Crawford county.

Coal is the most polluting fossil fuel, emitting dangerous toxic metal compounds, cancer-causing radioactive substances and sulfur oxides when burned. The federal Environmental Protection Agency (EPA) has mandated that scrubbers be installed in all coal-fueled plants constructed after 1977. Construction of all three coal-fueled Arkansas power plants began prior to 1978.

Arkansas utilities are burning low sulfur coal from Wyoming which provides less sulfur oxides. They did not install costly scrubbers because they can meet federal and state air standards without them. The plants do have a type of air filter (electrostatic percipitator) to remove most of the particulate matter produced from burning coal. When the utilites burn high sulfur Arkansas lignite they will have to add scrubbers to these new plants.

Coal, oil and natural gas are commonly called "fossil fuels" because they were formed from the fossil remains of ancient plants and animals over millions of years. Fossil fuels must be burned before energy can be released. Once burned they are gone. This energy is nonrenewable.

Coal is found underground all over the world. It is collected through mining and transported by railroad car, truck, barge or freighter. Heat from burning coal is used in many industrial processes such as in making steel. Coal heat is also used to run electric power plants. The coal heats water to form steam which turns a turbine and generates electrical energy.

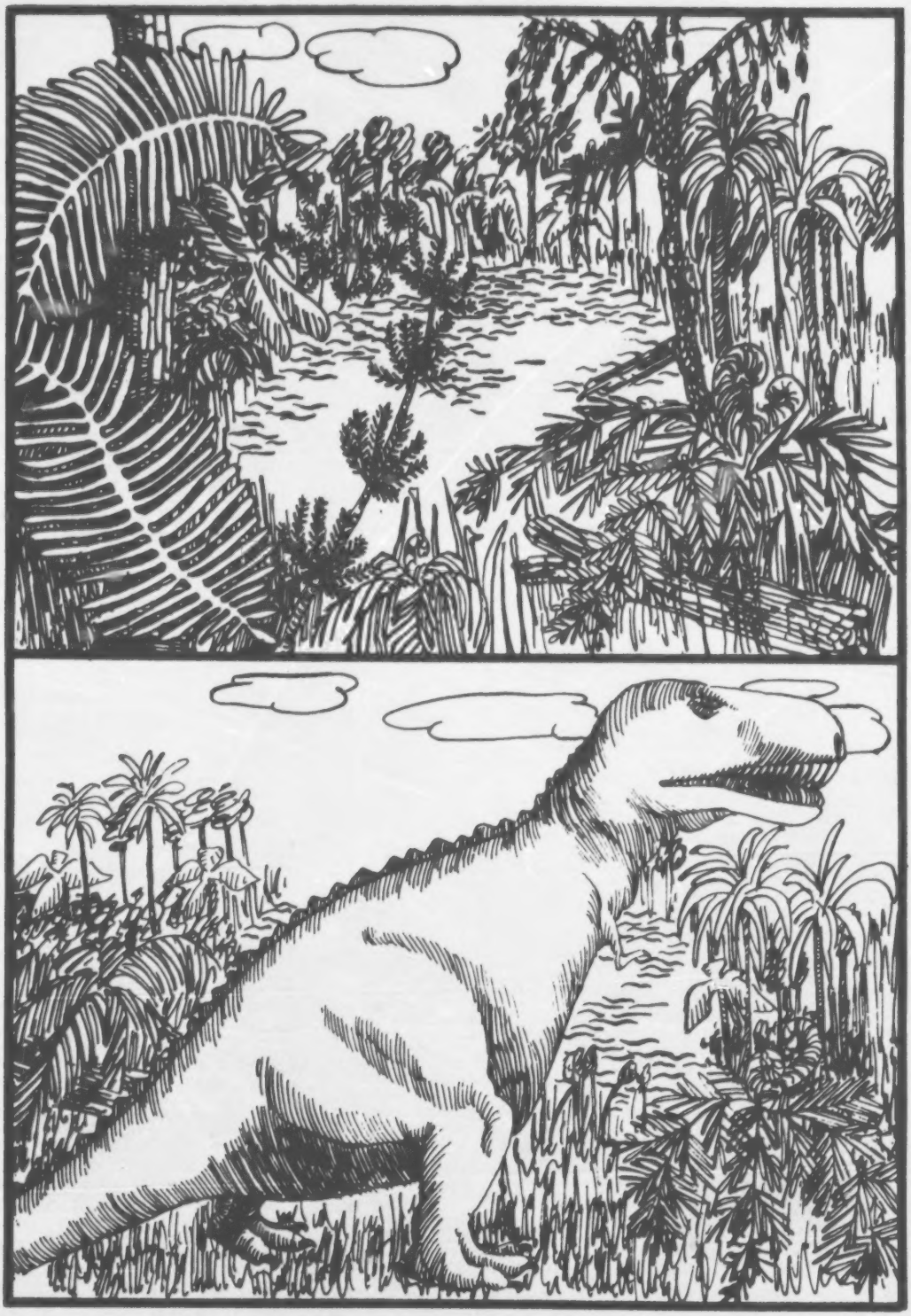
Oil found under the ground and under the sea is collected by drilling and transported by pipelines and in oil tankers. Oil has many uses. It is burned in diesel engines in trains and in trucks. It is converted to gasoline and used in cars. It can also be used to provide heat energy to run electric power plants.

Natural gas is found in underground wells, is collected by drilling and transported by pipelines and gas tankers and stored in tanks until used. Natural gas is burned in furnaces and stoves in homes, offices and factories.

## Student Worksheet

**The making of fossil fuels**

# MANY, MANY YEARS AGO

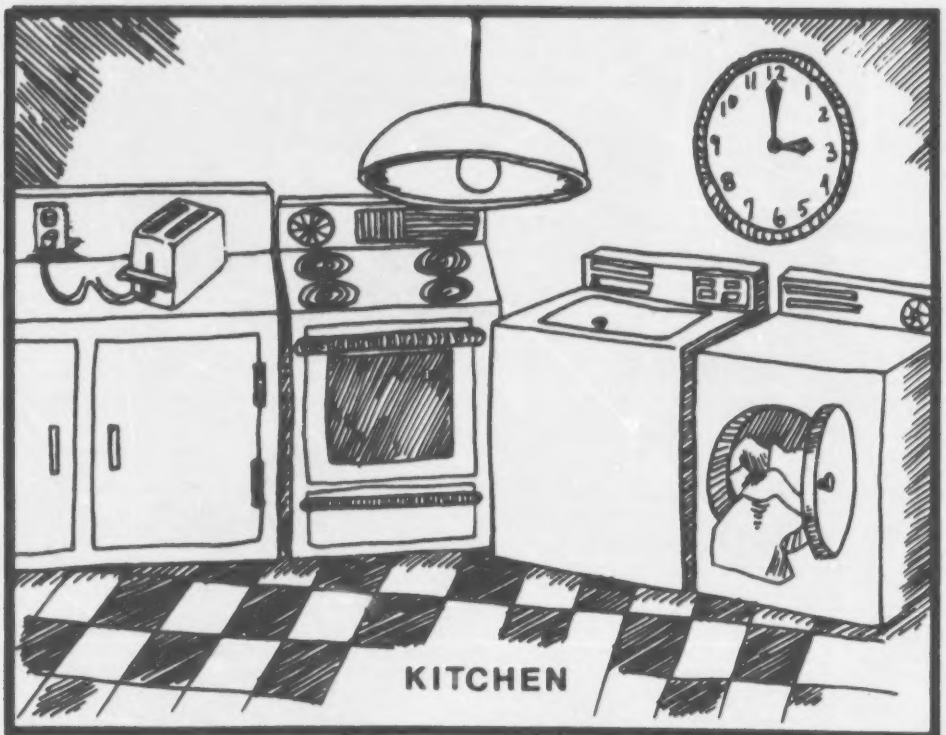


**Source:** United States Department of Energy

## Student Worksheet

**Heat and Light**

Which give off heat or light?
Color them orange.



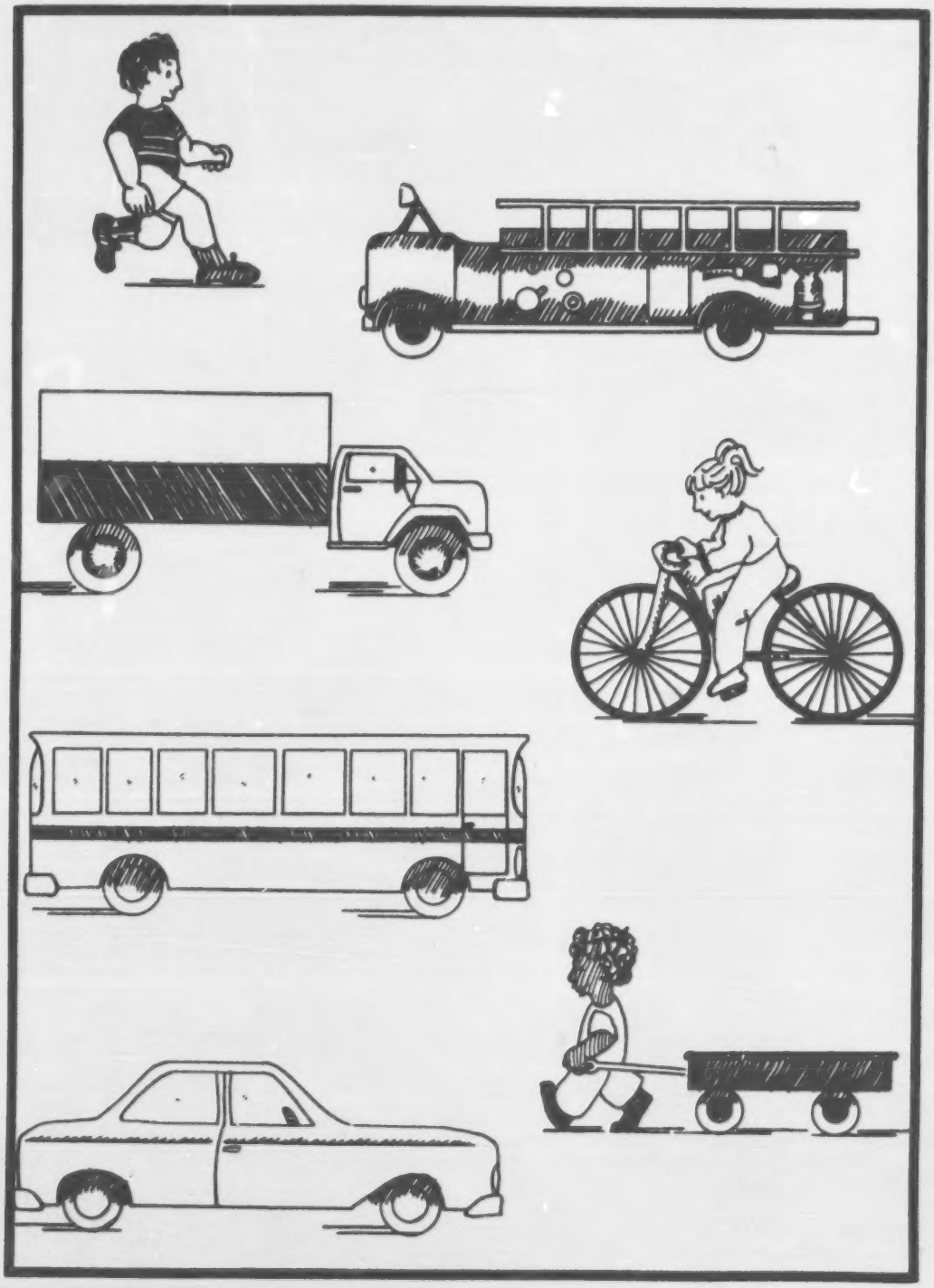
**Source:** United States Department of Energy

## Student Worksheet

Who needs gasoline?

**What things need gasoline or oil to move ?**

Circle them.





**Source:** United States Department of Energy

# Student Worksheet

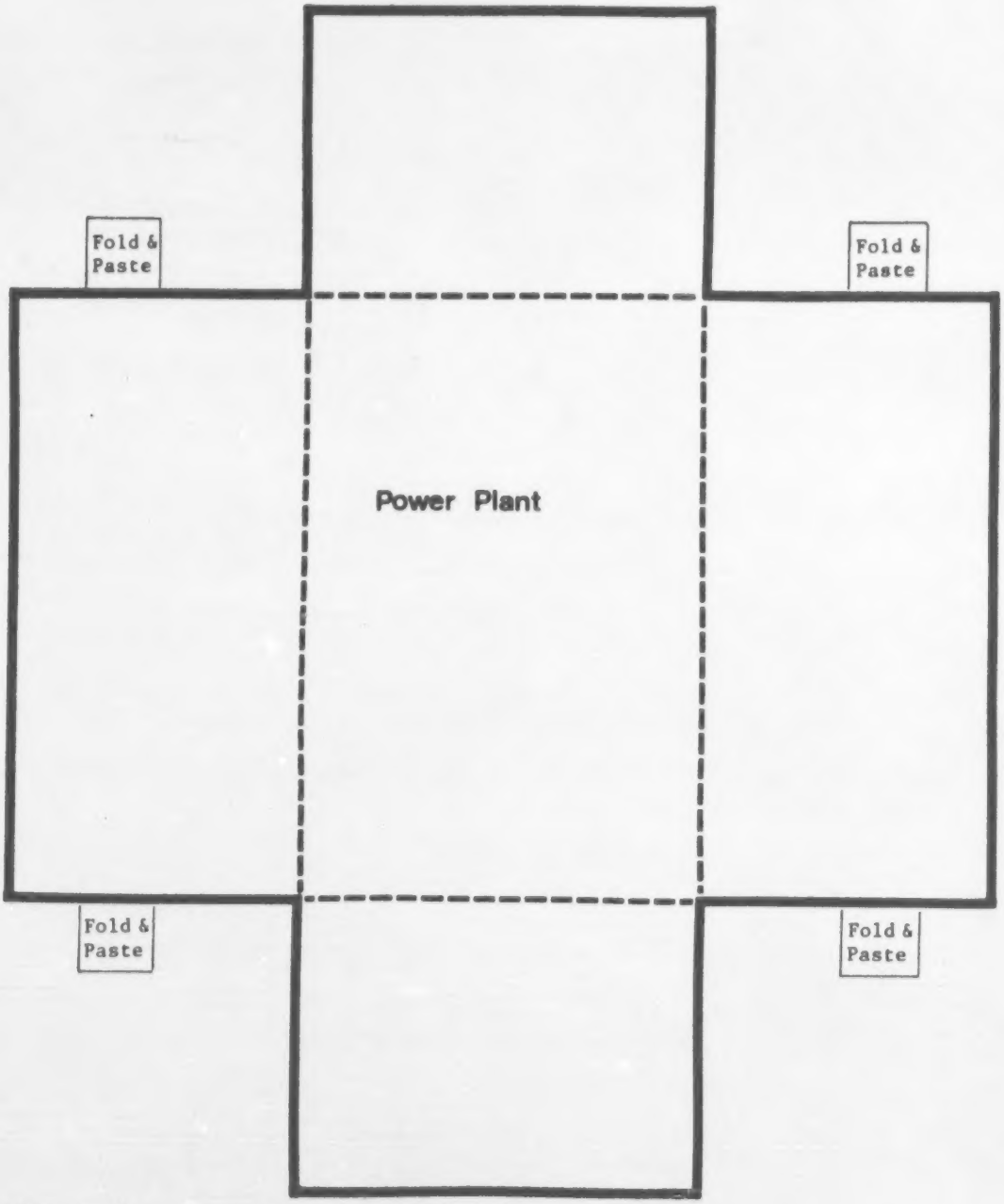
## Power Plant

**Telephone pole**

(Roll and put into clay base)

**Utility pole**

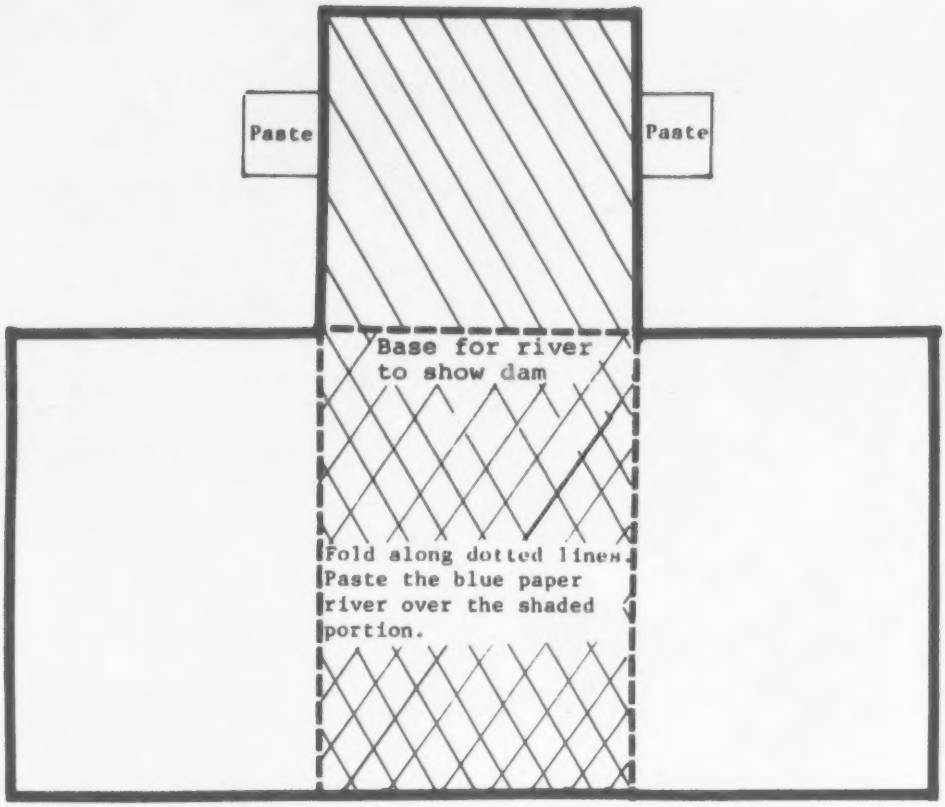
(Roll and put into clay base)

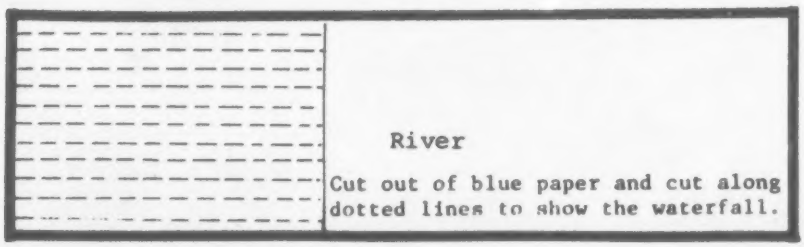


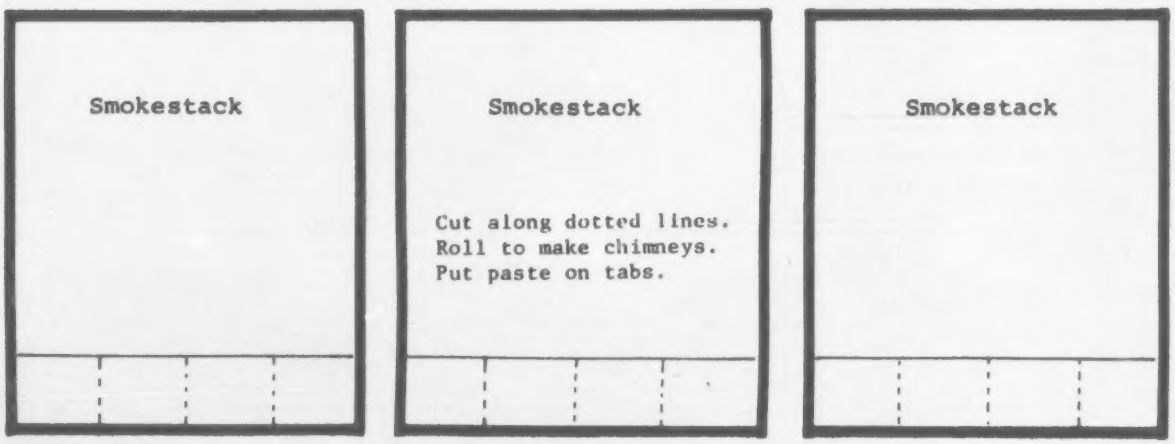

**Source:** United States Department of Energy

# Student Worksheet

## Dam

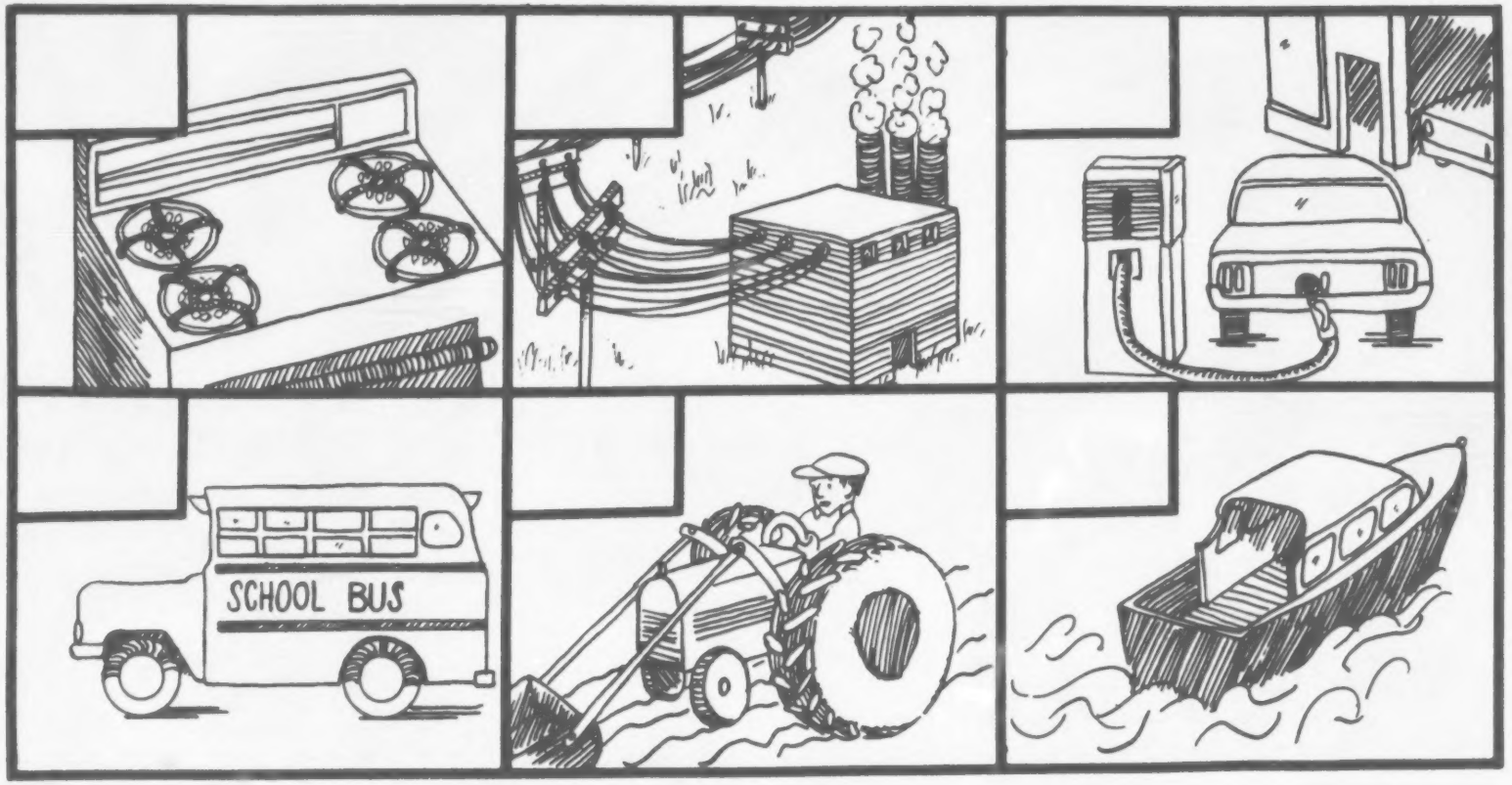



**Source:** United States Department of Energy

# WHAT DO WE USE?




KEY:

| | | | |
|---|---|---|---|
| C | COAL | G | NATURAL GAS |
| O | OIL or GASOLINE | E | ELECTRICITY |

Source: United States Department of Energy
6.11

LESSON #7

**CATEGORY:** Limits and Impacts

**ENERGY TYPE:** Oil

**TITLE:** Danger! Unfit for Human Use

**GRADE LEVEL:** 3

**SUBJECT AREA:**
Reading
Social Studies
Science

**TIME NEEDED:** Five periods

**MATERIALS:**
Map of local area--showing airport if possible
Three 3x5 cards per student
Some vaseline

**OBJECTIVES:**

1. The students will be able to state at least one cause of pollution by transportation vehicles on land, water and air.

2. The students will be able to state at least three methods of controlling or reducing pollution.

3. The students will infer that the use of energy in the form of gasoline can cause pollution of air, land and water.

**TASK ANALYSIS:**

The students should know how to record information on a chart and be familiar with the vocabulary used in the story "An Airplane in My Living Room," Student Worksheet 7.10.

**PROCEDURE:**

1. Preparation

   Read Teacher Background Information (7.6 and 7.7)
   Duplicate Student Worksheets 7.8-7.12.
   Collect materials listed above.

2. Steps in Lesson

   Objective #1: The students will be able to state at least one cause of pollution by transportation vehicles on land, water and air.

   Objective #2: The students will be able to state at least three methods of controlling or reducing pollution.

   Objective #3: The students will infer that the use of gasoline to produce energy can cause pollution of air, land and water.

In the following three activities, students are involved in collecting data, interpreting graphs and conducting investigations to determine the types of pollution caused by transportation vehicles on land, and in the air and water. Students are also give opportunities to explore and to suggest methods of controlling or reducing pollution.

## Polluting Our Land

a. Days 1 and 2: To introduce the lesson, tell students: "The newspapers, radio and television are often talking about pollution in our communities. What is pollution?" (List reponses. Pollution may be defined as damage to land, air, water or people.)

Say: "Today, let's look at a picture of a city and see if we can imagine the types of pollution that could be found there."

b. Distribute copies of Student Worksheet 7.8 and ask:
What kind of pollutants can you see? (Exhaust fumes, smog, congested traffic, litter, etc.)
Which kind can you feel? (Heat, chemicals which irritate the eyes and skin, etc.)
What kind of pollutants can you smell? (Exhaust fumes, smog, garbage, etc.)
What is causing most of these pollutants? (Cars, or burning gasoline in engines of cars, buses, trucks, taxis, etc.)
Is there any way that we can improve the situation in the city and eliminate some of the pollution? (List ideas on chalkboard. Possible responses: More people use buses or other public transportation; use electric cars; establish bicycle paths; reduce exhaust fumes; fine people for littering; carpool; drive less; decentralize work places; flex time for workers; etc.)

c. Distribute three 3x5 cards to each student. Tell them they may choose three places in their community to test the amount of pollution. In this way, they will become "pollution detectives."
Places may include shopping centers, factories, highway gasoline stations, homes, parks, schools, etc. Have each student write his/her name and the place being tested on one side of the card and cover the other side with vaseline. Tell them to place the cards in three places in their community, and in such a way that they will not blow away.

After two days have students bring in their cards and discuss the reasons for the discoloration and changed texture of the vaseline. Group cards according to the amount of discoloration. Record places on the chalkboard where pollution was measured using a chart divided into three categories: heavy, medium and light.

d. Ask: What do you think caused the pollution? Where are the places with "heavy pollution" located? Which areas seem to be the cleanest?
Have students copy the chart after it has been filled in and file it in their folders or put it in a notebook.

e. Ask the class to consider what they can do to reduce the pollution in their community.
(Collect litter; recycle aluminum/newspapers; publish a class newsletter reminding others of ways to reduce pollution; make posters; ride bicycles whenever possible; etc.)

## Polluting the Air We Breathe

f. Day 3: Continue the lesson on pollution by examiming pollution caused by airplanes. Begin by asking students: "What other kinds of transportation besides cars, buses, etc. cause pollution?" (List these on the chalkboard. Possible responses: Airplanes--commercial and

private, ships, pleasure boats, etc.) "Today we are going to pretend that we are at an airport and try to find out what types of pollutants we find there."

g. Distribute copies of Student Worksheet 7.9. Ask students to examine the picture and ask the following questions:

Are there any pollutants that you can see? Hear? Smell? Feel? (Possible responses: Jet exhaust, sound of engine, general noise, heat from engines, etc.)
What is smog? Can we smell and "see" smog? (Discuss the origin of the word which combines smoke and fog. Mention that smog stings the eyes and makes breathing more difficult.)
What in the picture might cause smoke? (Plane engine exhaust)
What can cause noise? (Sound of engines)
What can cause heat? (Burning of fuel in the engines)
Are most airports located inside the city or outside? (Outside) Why do you think planners do this?
Do you think people like to live near an airport? Why or why not?
Where is our nearest airport located? (Locate it on a local map.)
Have people in our community ever had problems with the airport?
Have you ever heard of people in other places complaining about airplanes or airports? (Possible responses: relatives who live near big airports or people who remember the Concord's noise problem in New York and Washington, D.C.)
What can be done about pollutants caused by airplanes? (List responses on the chalkboard. (Possible responses: Reduce noise of engines, locate airports in nonresidential areas, reduce jet exhaust, etc.)

h. Say: "Let's read a story about a boy who lived near an airport and see how he felt about it." (Distribute copies of Student Worksheet 7.10 (An Airplane in My Living Room) and select several students to read sections aloud while others read silently.

Briefly discuss the story by asking:
What types of pollution bothered Gary? (Noise and exhaust fumes)
Do you think Gary lives near an airport? Why or why not?
What is a vibration? (Vibration is back and forth movement.) Have you ever seen anything vibrate? (Guitar strings, engines, bees' wings, etc.)

For homework, students might re-read the story and write at least three questions that Gary could ask his teacher.

i. Have students complete the following questions:

Two pollutants made by airplanes are (noise) and (fumes).
Airplanes will cause less pollution if we (either make better engines or reduce the noise they make).

j. Student Evaluation

Reinforce vocabulary words by having students fill in the puzzle on Student Worksheet 7.11 and find the mystery word. The mystery word completes the fuselage of the airplane.

Puzzle Answer Key

Across

2. Loud sound. (noise)
3. Place for airplanes to land and take off. (airport)
4. What is burned in an airplane engine? (fuel)
5. Engine part where smelly fumes come from. (exhaust)
6. Kind of engine used in many planes. (jet)
7. Name for back and forth movements. (vibrations)
8. Air that has a lot of smoke and fog in it. (smog)

Down

1. Mystery word a i r p o l l u t i o n

k. Enrichment Activities

—Take a field trip if possible to an airport. Take along a portable tape recorder to record the sound. Play it back later and ask students: Would we mind hearing this sound all day long?

—Collect newspaper and/or magazine articles related to community problems with airplanes or airports.

—Interview one or more people who live near an airport and ask them how it affects their lives.

## Polluting Our Water

1. Days 4 and 5: Begin the lesson by having students review the types of pollution they have learned about so far. Discuss the types of pollution caused by transportation vehicles on land and in the air.

Make a chart like the one pictured below on your chalkboard. Leave parts of the chart blank and ask students to come to the chalkboard and fill in what is missing.

**WHAT DO WE DO NOW?**

**Transportation and Pollution**

| | Kind | Pollution | Next Step |
|---|---|---|---|
| Land | car<br>motorcycle<br>bus | exhaust fumes<br>noise<br>litter | better engines<br>fines for littering<br>inform people of problems of littering |
| Air | airplanes<br>helicopters<br>private planes | exhaust fumes<br>noise | location of airports<br>better engines<br>control of exhaust |
| Water | ships<br>oil tankers<br>submarines<br>pleasure boats<br>sailboats | oil spills<br>exhaust fumes<br>noise<br>spoiled beaches | better tankers<br>quieter engines<br>fines for spoiling beaches |

m. Ask: What kinds of vehicles travel on water? (Ships, pleasure boats, tankers, sailboats, Navy submarines, etc.)

n. Distribute copies of Student Worksheet 7.12 (What Happened Here?). Ask students to look for examples of water pollution. (Possible responses: Oil leak, fish and birds covered with oil, people littering from boats, beach polluted by oil and ruined for swimming.)

o. Discuss why it is necessary to have oil transported in tanker ships? (Possible responses: To supplement our own supply; it is cheaper to bring it in by ship to some places than to use train or truck; a ship can carry more oil than a truck; some areas which need oil do not have railroad service.)

p. Have students make posters showing people how to reduce water pollution.

3. Evaluation

a. Make a matching test like the one below or write on chalkboard and have students come forward and draw lines matching answers.

| | |
|---|---|
| 1. Pollution | a. A pollution caused by airplanes |
| 2. Oil spill | b. One way to have less pollution in the city |
| 3. Noise | c. A pollution caused by tanker ships |
| 4. Public transportation | d. Less exhaust fumes |
| 5. Better engines | e. Damage to land, air or water |

b. Review with students show to make a chart and then have them reorder the words given below and organize them into a meaningful chart. Write the words on the chalkboard or give each student a copy of them.

| | | |
|---|---|---|
| land | oil spills | noise |
| exhaust fumes | better engines | quieter engines |
| pollution | airplanes | air |
| water | cars | oil tankers |
| better tankers | | |

Answer Key

| | | | |
|---|---|---|---|
| land | cars | exhaust fumes | better engines |
| water | oil tankers | oil spills | better tankers |
| air | airplanes | noise | quieter engines |

Have students suggest appropriate headings for each column, such as Pollution for column 3, Kind over column 2, etc.

Sources:

Paul L. Butt. Arkansas and Energy: A Look at the Alternatives. Arkansas Ecology Center: Little Rock. 1979.

Environmental Protection Agency. Better Health and Regulatory Reform. Environmental Protection Agency: Washington, D.C. 1979.

United States Department of Energy. Energy, the Environment and the Economy. United States Department of Energy: Washington, D.C. 1980.

The problem of pollution costs a great deal in terms of the damage to health, effects on materials (rust and corrosion, need for repainting, cost of protective coatings), damage to residential properties (reduction of values of property), and damage to vegetation. At the present time most of these costs are being borne by the public.

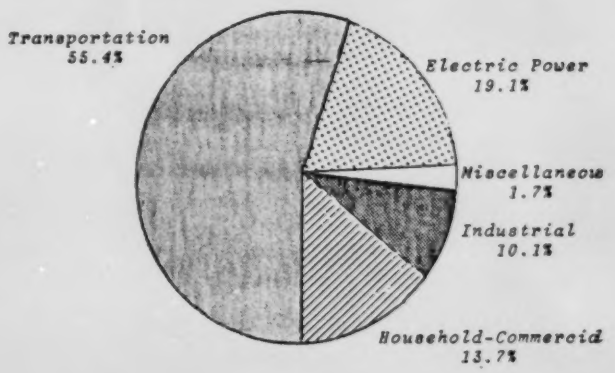
The exhaust from automobile and other vehicles of transportation are major contributors to the problem of air pollution. Two of the pollutants emitted from exhaust are lead and carbon monoxide. Cars also provide the ingredients for the smog that bothers eyes and nose on hot, still summer days.

As shown by the pie diagram below, over 55 per cent of petroleum products in Arkansas are used for transportation. In gasoline consumption per capita--and per registered motor vehicle--Arkansas is above the national average. In recent years, in fact, Arkansas has ranked at or near the top of all the state in gasoline use per capita and per registered motor vehicle.

This higher use of gasoline is due in part to the rural, and thus dispersed, population. There is also, generally, a lack of well-developed public transit systems in the state.

Another reason for Arkansas' high per capita gasoline use is its vehicle make-up (23 per cent trucks) and its "Sunbelt" location. Milder winters make the driving season much longer than that of the "Snowbelt" states.

**ARKANSAS CONSUMPTION OF PETROLEUM PRODUCTS BY USE 1978**




Source: Arkansas Department of Energy

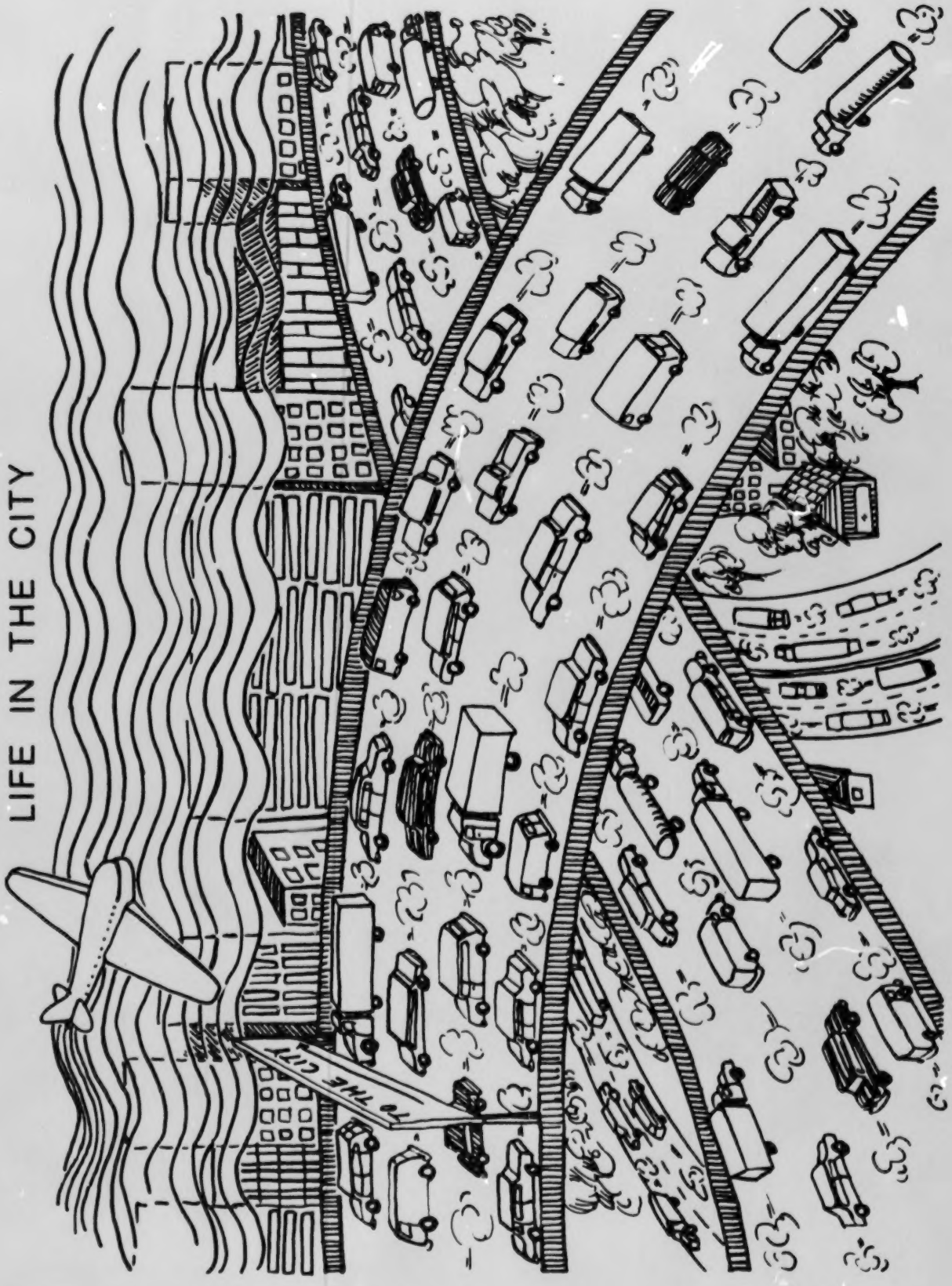
According to the Arkansas Department of Energy, gasoline use in Arkansas increased at an average annual rate of about 2 1/2 per cent from 1973 to 1978. In 1979, gasoline demand was down 6 per cent from demand in 1978--the first time since the Organization of Petroleum Exporting Countries oil embargo of 1973-74 that demand dropped. It is expected that over the next decade, assuming no major supply interruption, gasoline use will continue to decline at an average rate of about 2 per cent.

In water pollution and land use pollution, energy consumption is only one factor, but air pollution is almost exclusively the result of discharges from motor vehicles (the chief source), fossil-fueled electric power plants and energy-intensive industries.

Noise is another example of air pollution brought about by the use of energy for transportation. Large jets taking off and landing, city traffic, sirens, horns and other city noises can be harmful to man and his environment.

According to a 1979 Environmental Protection Agency report, there is growing evidence that excessive noise contributes to the development of high blood pressure and other heart and circulatory problems. For example, a recent study found that grade school children living and going to school under aircraft flight paths had higher blood pressure than children in a quieter community.

Under the Noise Control Act of 1972, EPA is required to issue regulations controlling newly manufactured products that are major sources of noise. Early under the law EPA issued regulations for portable air compressors and medium and heavy trucks. And by 1985, the EPA's regulation should result in a five decibel reduction in noise from new motorcycles on city streets.




**Source:** United States Department of Energy

# AIRPORT

103

104

**Source:** United States Department of Energy

# Student Worksheet

## An Airplane in My Living Room

Gary was sitting in his living room watching his favorite television program, "Sesame Street". All of a sudden he heard a low pitched hum. It grew louder and louder, and the pitch became higher and higher. R-R-R-R-R-R-Z-O-O-O-M! Finally, it became so loud that Gary could not hear what Big Bird was saying.

Gary went outside to see what was causing the noise. It was a jet plane and it was moving fast!

"Jets sure make a lot of noise!" said Gary.

Gary observed many things about the jet. He could see the smoke from the engine, he could also smell the smoke. He knew a word for the noise, smoke and bad smell--pollution. He could still feel the vibrations and his ears began to hurt.

When something moves back and forth, it is vibrating. When the engine of a jet is vibrating slowly the sound cannot be heard. But as the engine vibrates faster and faster, the sound becomes louder and louder.

Gary thought about the airplane noise and exhaust smoke for a long time. When he went back to his living room, he wrote down some questions to ask his teacher the next day. What questions do you think he wrote?

Possible Questions:

1. What caused the sound of the jet to become louder?
2. Why does the noise from the airplane make my ears hurt?
3. Does the pollution hurt plants too?



**Source:** United States Department of Energy

## Student Worksheet

LEARNING NEW WORDS ABOUT AIR POLLUTION

Find and write the missing letters in the airplane puzzle. Write the mystery word in the blanks below the puzzle.

Across

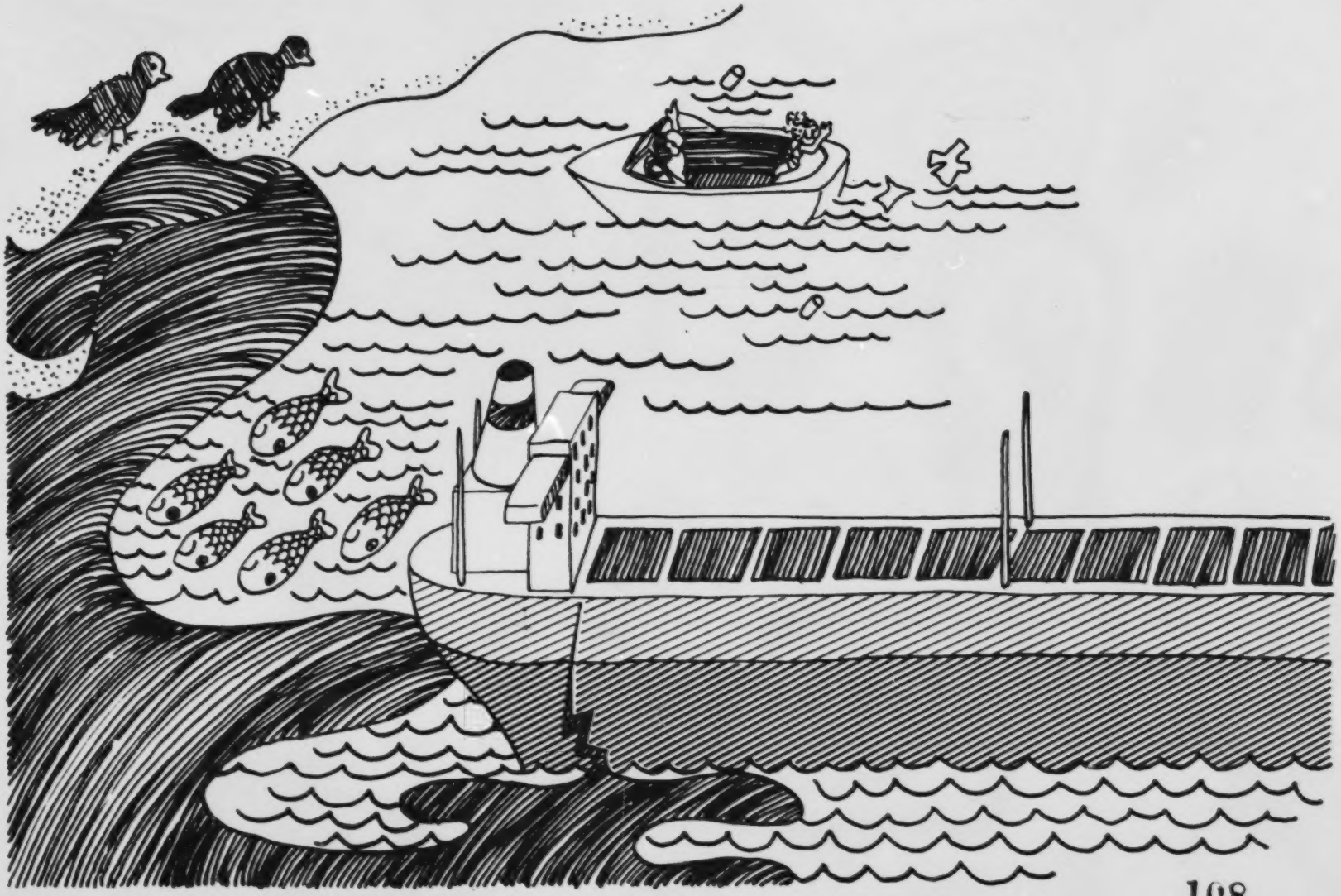
2. Loud sound
3. Place for airplanes to land and take off.
4. What is burned in an airplane engine?
5. Engine part where smelly fumes come from.
6. Kind of engine used in many planes.
7. Name for back and forth movements.
8. Air that has a lot of smoke and fog in it.

Down

1. Mystery word _ _ _ _ _ _ _ _ _ _ _

**Source:** United States Department of Energy

# WHAT HAPPENED HERE?



**Source:** United States Department of Energy

7.12





**Student Worksheet**

LESSON #8

**CATEGORY:** Sources, Limits and Impacts

**ENERGY TYPE:** Solar, Fossil Fuels, Hydro, Nuclear, Geothermal

**TITLE:** The Best Present of All

**GRADE LEVEL:** 2-3

**SUBJECT AREA:**
Reading
Language Arts
Science

**TIME NEEDED:** Two weeks

**MATERIALS:**
Magic markers
Crayons
Construction paper
And any other supplies that might help in the production of costumes for the play (See costume descriptions included in play.)

**OBJECTIVES:**

1. The students will understand the vocabulary used in the play.
2. The students will be able to read and memorize their parts for the play, "The Best Present of All."
3. The students will learn to innovate and produce posters, props and costumes for the play.
4. The students will understand the positive and negative factors involved in the use of various energy sources.
5. The students will apply what they learn in the play to real life.

**TASK ANALYSIS:**

The students should be familiar with the vocabulary in the play; and be able to work independently or in small groups on costumes, posters or set design.

**PROCEDURE:**

1. Preparation

   Read over the play and pick out vocabulary words that students may have problems reading and understanding.

   Make up sentences using these words for vocabulary.

   Duplicate enough copies of the play (Student Worksheets 8.4-8.7) for the whole class.

   Gather some material scraps, a dirty vacuum cleaner bag (for Mr./Ms. Coal), some molasses (for Mr./Ms. Oil) and any other items that might help in making costumes for the characters.

2. Steps in Lesson

Objective #1: The students will understand the vocabulary used in the play.

Objective #2: The students will be able to read and memorize their parts for the play, "The Best Present of All".

Objective #3: The students will learn to innovate and produce posters, props and costumes for the play.

a. Present vocabulary words in sentences for students to learn or make a spelling exercise designed to help students learn the words used in the play.
Sample words: page boy, sire, understand, warmth, light, forever, fuel, oil, gas, coal, atom, geothermal, air pollution, clean, poison, radioactivity, energy, windmills.

b. Pass out copies of the play and read through it with students.

c. Assign parts, making sure everyone is involved either in the cast or as stage helpers.

d. Divide the class into groups and begin working on posters to advertise the play, costumes and a simple set.

e. Invite other classes and parents to come see the play.

Objective #4: The students will understand the positive and negative factors involved in the use of various energy sources.

Objective #5: The students will apply what they learn in the play to real life.

a. After the play has been performed, review what they have learned from the story. Ask the children what materials can be used to produce heat and light energy. Discuss the pros and cons of each form of energy. These may be among the things mentioned:

| Form of Energy | Advantages | Disadvantages |
|---|---|---|
| Oil | Easy to transport<br>Has many uses besides burning it for energy (petrochemicals) | Expensive<br>Limited supply<br>May leak and spill<br>Pollutes the air |
| Natural Gas | Clean<br>Has many uses besides burning it for energy (petrochemicals) | Expensive<br>Limited supply |
| Coal | More available | Pollutes the air<br>May spoil the land (strip mining) |

| Form of energy | Advantages | Disadvantages |
|---|---|---|
| Atoms | Available<br>Clean | Poisonous waste |
| Water | Clean | May spoil streams<br>Not enough available |
| Geothermal | Clean<br>No poisonous waste | Available only in limited places |
| Direct Sun | Unlimited amount available<br>Clean | Scattered, has to be collected to be useable |
| Wind | Clean | Not always available |

3. Evaluation

a. The success of the activity can best be judged by comments and reactions to the play itself. Also, student learning may be measured by how well students respond to the review of pros and cons after the play is finished.

# Student Worksheet

## THE BEST PRESENT OF ALL

(Adapted from RANGER RICK'S NATURE MAGAZINE, Copyright 1974, by permission of the publisher, the National Wildlife Federation.)

### CHARACTERS

| | |
|---|---|
| Narrator | Mr./Ms. Gas |
| King Oliver/Queen Olivia | Mr./Ms. Coal |
| Wise Ones (four) | Mr./Ms. Atom |
| Page Boy/Girl | Mr./Ms. Geothermal |
| Mr./Ms. Oil | General Water |

The Golden Sun

Note to teachers: You can extend the list by including people of the court. Some students might work as stage hands to decorate and set up the throne. Others might form a committee to hand out lollipops at the end of the play. Some might even be artists who make posters to advertise the play. Also, the characters are interchangeable in gender, depending on your male/female class ratio, you may want to make changes.

Scene 1: The Castle

**NARRATOR:** Once upon a time a great king named Oliver lived in a cold dark castle. Because he loved the children in his land he invited them to come to a wonderful party with ice cream and cookies and lollipops to eat. King Oliver wanted his party for the children to be extra-special-special. He wanted to give them "the best present of all"--a present to last forever.

**KING:** Page, come here.

**PAGE:** Yes, sire.

**KING:** Go and fetch my four wise ones. I wish to ask their advice on a matter of great importance.

**PAGE:** Yes, sire. (Page leaves "shivering" and comes back immediately with the four wise ones.)

**WISE ONES:** You wanted us, sire?

**KING:** (Gathering his robe closely about him as he shivers) My dear friends, I want you to help me think of "the best present of all."

**FIRST WISE ONE:** I beg your pardon, sire. . .

**SECOND WISE ONE:** Present for whom, your highness?

**KING:** Why, for all the children in this great land. And for the children's children. It must be something extra-special-special!

(The king and all four wise ones sit down in the cold castle to think of a present.")

**PAGE:** (wishing out loud) I wish I could get warm. . .

**KING:** That's it! Oh, thank you, child. You have given me the answer.

**THIRD WISE ONE:** But, I don't understand. . .

**KING:** It's simple. I will give the children warmth and light forever.

**FOURTH WISE ONE:** Sire, I know a way to make warmth and light. You build a fire to boil water and use the steam to warm the castle and also to turn a motor which can make the lights work.

**KING:** Wonderful! Now we are getting somewhere.

**FOURTH WISE ONE:** But there's one problem. . .finding enough fuel to keep the fire going.

**KING:** Well, we must learn something about these fuels. Who are they?

**FIRST WISE ONE:** Sire, there are many. There is Ms. Oil. And Mr. Gas. And Mr. Coal.

**SECOND WISE ONE:** And Ms. Atom. And General Water. And Ms. Geothermal.

**KING:** Stop! I am growing tired. Let us invite these powerful fuels to come to the castle tomorrow so we can find out more about them. (He calls page and motions for him/her to go find these fuels.)
Tommorrow, we will find out what each one has to offer and also what problems each may cause to our people and our country. For now, good friends, good night.

(Curtain.)

Scene 2: The Castle. Next day.

**PAGE:** Your highness, all the energy sources you invited have arrived. Ms. Oil and Mr. Gas are in a hurry. Shall I bring them in first?

**KING:** Yes, yes. Show them in.

(Ms. Oil and Mr. Gas come in together. Ms. Oil is large and messy and leaves oily footprints when she walks. Mr. Gas is small and timid. He is very neat and clean looking.)

**KING:** My powerful friends, how can I make energy to heat and light my children forever?

**MS. OIL:** I am really clean, sire. It is just because there are so many cars using me that there is air pollution.

**MR. GAS:** And I am even cleaner. When you burn me, I do not make much pollution.

**KING:** Then you are the answer to my problem. Ms. Oil and Mr. Gas you will warm my children forever and light their homes.

**MS. OIL:** Well, there's just one thing, sire. We cannot stay forever. Once we are burned, we are gone.

**MR. GAS:** (timidly nodding his head) That is true, King Oliver. We cannot be used over and over again. . .only once. We took millions of years to form and there's not much of us left in the earth.

(The king frowns.)

**KING:** (clapping his hands) Off with you, then. My present must last forever.

(Mr. Coal comes in next. He is a giant, covered with black stones and leaves dirty dusty puffs of coal when he walks.)

**KING:** Mr. Coal, how can you help me heat and light my children's homes forever?

**MR. COAL:** Your majesty, I cannot burn clean. Little pieces of poison will get into the air and in people's clothes and lungs if I am used. But there is enough of me to last a long time. All you have to do is push away the grass and trees and dig me up.

**KING:** (frowning again) No, Mr. Coal, you will not do. I do not want my children to have dirty air or lose their trees and grass.

(Ms. Atom comes in next. She is a very shiny neat person who bounces when she walks.)

**KING:** So you are Ms. Atom whom I've heard so much about. Many people are frightened of your power. How can you help me heat and light my children's homes forever?

**MS. ATOM:** Sire, I can split and make energy. I get very, very hot and am so full of energy that I split, letting it out. Oh, some people are afraid of the poison that is released when I split. It is called radioactivity. But if you can put the poison in a thick-walled box and store it for a very long time, the poison will disappear.

**KING:** No, no, Ms. Atom. I am sorry. But I do not want my children to have to worry about your poison. Send in General Water.

(General Water marches in and salutes everyone.)

**GENERAL WATER:** Sir, I will flood the valleys and rivers and make a dam. And that dam will use the power of moving water to make energy for heat and light.

**KING:** But I don't want to destroy the land or hurt the children. And your dams could break. No, that will never do. Send in Ms. Geothermal.

(Ms. Geothermal enters. She is very round and clean and she puffs and huffs when she walks.)

# Student Worksheet

(The Play, page 4)

**MS. GEOTHERMAL:** King Oliver, mine is a natural kind of energy. I use heat already inside the earth to warm homes and turn motors. I can be pumped out of the earth and the land does not have to be destroyed. However, I can't be found everywhere, only in some places.

(King Oliver smiles. He asks Ms. Geothermal to sit beside him. He wants to hear more about this kind of energy. Suddenly the room is filled with warmth and light. Everyone gasps. Before them stands The Golden Sun. She is like a beautiful golden butterly. Her dress shines like a thousand golden coins and when she smiles all the room is warm.)

**THE GOLDEN SUN:** Dear King Oliver. I am the golden sun. My energy makes plants and people grow.

**KING:** But how can that help warm and light my children's homes?

**THE GOLDEN SUN:** My warmth can be caught in a basket of stones and let out at night to warm a house. And I can make the wind blow to turn motors to make the lights work. If the King would only build his houses to catch my rays and build windmills to use my wind, then his children could have warmth and light forever--because I am here always.

**NARRATOR:** Then The Golden Sun left the king's castle to visit the other side of the earth. The king spread his arms wide. He smiled a happy smile. He had a wonderfully good present for his children--warmth and light from the earth and the sun. And guess what else? Ice cream and cookies and lollipops!

(Students begin throwing lollipops into the audience.)

(Curtain)

# LESSON #9

**CATEGORY:** Conservation

**ENERGY TYPE:** Natural gas, Propane, Electricity, Solar

**TITLE:** Let's Go Back in Time. . .

**GRADE LEVEL:** K-1

**SUBJECT AREA:**
Social Studies
Language Arts

**TIME NEEDED:** One or two periods

**MATERIALS:**
If class makes solar hot dog cooker, see materials list on page 9.5.
No other special materials are required.

**OBJECTIVES:**

1. The students will become aware of the connection between the use of energy and the ways in which they live.

2. The students will be able to make a solar hot dog cooker by following oral instructions of teacher.

**TASK ANALYSIS:**
Students should be able to follow directions; and be familiar with the vocabulary terms: Energy, natural gas, propane, electricity and solar.

**PROCEDURE:**

1. Preparation

   Read Teacher Background Information about The History of Solar Energy (9.3 and 9.4).

   Introduce the necessary vocabulary terms by asking students to make sentences using the words: energy, natural gas, electricity and solar.

   Gather materials needed for making solar hot dog cooker (see 9.5-9.6).

2. Steps in Lesson

   Objective #1: The students will become aware of the connection between the use of energy and the ways in which they live.

   a. Have students pretend they are living in the old times when people crossed the country in covered wagons. They are out in the open country and it is getting dark. It is also getting cold. Ask students how they can make themselves warm.
      Ask: Can we turn the thermostat up like we do at home? (No.)
      Ask: How did people in old times keep warm? (Built fires.)
      Have the children pretend they are gathering wood and have them make a pretend fire in the middle of the room. As students sit around the campfire, ask them if they are getting hungry.

Ask: Will someone tell us how we can cook our food without a stove? (Use the fire.)

Introduce the words natural gas, propane and electricity to indicate how we cook our food today. Then talk about using the sun to cook food and to dry food.

Ask: Can you think of other things that we have today that were not available in frontier days? (TV, electric lights, radio, etc.)

b. Have students give problems that might arise if everyone went back to cooking on an open fire and write them on the chalkboard. (Smoke pollutes the air, wood will grow scarce, etc.)

c. Set up a small frontier village letting students pretend to be blacksmiths, teachers, farmers, ranchers, craftsmen and merchants. Appoint one child to be the timber salesperson. Tell students that he/she owns all the timber land around the village and they must buy their wood from him/her.

Ask: Who will become the richest person in the village? (the timber salesperson)

Why? (because everyone needs wood in order to cook his/her food and keep warm)

Note: Girls may be cast in any of above roles as well as boys.

d. See if students can make the connection between the timber salesperson and the utility companies today. Both are selling something people need. Encourage creative thinking; how are new discoveries and inventions most often made? (in response to a need such as higher prices for a needed item)

Objective #2: The students will be able to make a solar hot dog cooker by following oral instructions of teacher. (The teacher may want to make the cooker at home and just demonstrate how it works for the class.)

Assemble materials listed on page 9.5 and follow instructions.

3. Evaluation

Observe how well students make the connection between use of energy and how they live.

## TEACHER BACKGROUND INFORMATION

Source:

United States Department of Energy. A Solar Energy Curriculum for Elementary Schools K-6. United States Department of Energy: Washington, D.C. 1980.

In prehistoric times, it may have been obvious to human beings that the sun was essential to life on earth, giving off light and heat. Many of the early cultures that developed identified the sun as a god, the creator of life on earth. The Aztecs, Incas, Babylonians, and Egyptians were sun god worshippers.

Direct, natural use of the sun has been practiced since the beginning of agriculture, not only for growing plants but also for drying fruits, vegetables, and other crops. Early civilization explored other ways of utilizing solar energy. The Egyptians found ways to store solar heat through transparent surfaces. The Arabs used solar energy to distill brackish water. The Aztecs used solar energy to dry clay pottery and vessels. Southwest American Indians--cliff dwellers--used sophisticated knowledge to build their pueblos for maximum solar efficiency, summer and winter.

An unusual use of solar energy was made by Archimedes in a military confrontation betweeen Greek soldiers and an invading Roman fleet in the harbor of Syracuse, Greece, in 212 B.C. The story is told that the Greek soldiers lined up along the harbor and used their shields to reflect sunlight on the invading Roman fleet. The high concentration of sunlight focused on the warships was enough to set fire to them.

With the advent of glass occurring around the first century A.D., public bath houses and expensive homes built by Roman craftsmen were kept warm using glass windows for trapping solar heat.

Little scientific progress occurred in solar energy after the advent of glass until the Renaissance. Some advancement had been made in the science of observing, and optics by Roger Bacon through the use of lenses and spherical crystals.

Interest in solar energy increased during the Renaissance era as scientists used solar devices in their experiments to burn substances, raise water, and to heat or melt metals. Eighteen-hundred years after the story of Archimedes, in the seventeenth century, Athanasius Kircher performed some experiments to set fire to a woodpile at a distance in order to determine the validity of the story of Archimedes.

Further investigation led by George Buffon demonstrated in 1747, that a woodpile 60 meters (197 feet) away can be ignited using a number of small flat mirrors. Count Buffon concluded that Archimedes' feat in burning the Roman warships was possible.

Antoine Lavoisier, the founder of modern chemistry, discovered oxygen as the gas produced by intense heat concentrated onto mercuric oxide by a system of lenses directed toward the sun (1774). Temperatures up to 1760 degrees Celsius (3200 degrees Fahrenheit) were produced by the lens system.

In 1839, an attempt to generate an electric current by action to sunlight was successfully accomplished by A. E. Bequerel. In the latter half of the century, attempts were made to convert solar energy into other energy forms such as generating steam to operate steam engines. A notable advance was made in the latter half of the 1800's by a Frenchman named August Mouchot. He designed a cone-shaped collector called axicon. Unlike lenses and other reflecting devices which focused over a small area producing extremely high temperatures, the Axicon focused sunlight over a wide area producing moderate temperatures. Able Pifre, a contemporary of Mouchot, developed parabolic reflectors similar in shape to Mouchot's cone. Pifre's solar engine, demonstrated at the Paris Exhibition in 1878, was used to drive a printing press.

In 1872, large scale utilization of solar energy was developed in Chile by Wilson. A solar still was built to provide much needed fresh water from salt water. This still operated for 40 years and supplied up to 6,000 gallons of fresh water per day.

Significant developments were occurring at the dawn of the twentieth century. New ideas began to crop up as combined solar-steam powered devices and storage batteries were developed as possible power systems. Experimenters were using more sophisticated engines to improve efficiencies. A different approach to solar engines was developed by Willsie and Boyle from 1902 to 1908. They used what is now known as flat plate collectors to absorb sunlight. These units became well developed for domestic hot water heating in the southwestern United States and Florida. But with the discovery of cheap oil and natural gas that occurred, solar hot water systems became much less competitive than gas-fired water heaters.

In 1912, Frank Shuman and others developed the world's largest solar pumping plant in Egypt. The steam supplied to the steam engine used to drive the water pump was produced by parabolic cylinders reflecting light onto an absorber tube. Each cylinder was 62 meters long with a total area of 1,200 square meters.

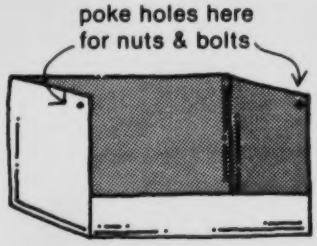
Development of solar energy for practical purposes has long been delayed due to cheap fossil fuel costs. But in the area of hot water heating, there is more success. Many solar hot water systems in the United States and elsewhere remain in use.

Developments made by Bell Telephones' scientists in the 1950's greatly improved solar energy conversion into electricity, first made by Berquerel in 1839. The new photovoltaic cell later became useful in providing power for spacecraft. This new energy source was promising to space exploration as a cheap power supply, but compared to providing domestic power on earth, conventional electricity generating systems such as steam turbine power plants cost far less.

# HOW LONG DOES IT TAKE TO COOK A WITH THE SUN?

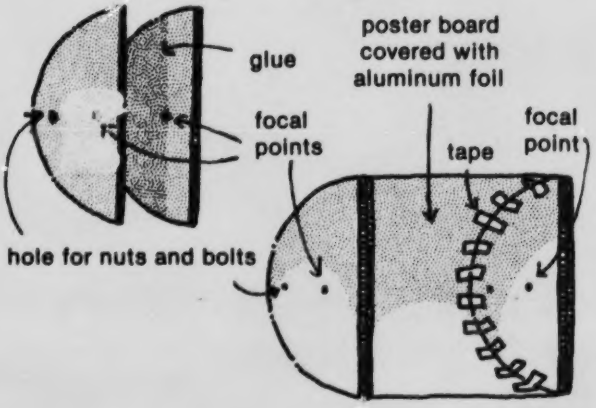
## MATERIALS:

1 Hot dog
2 Cardboard boxes; 2 small nuts & 2 bolts
Aluminum foil
Coathanger (unpainted)
Scissors; rubber cement
Black foil
Poster board, 28cm × 34.5cm



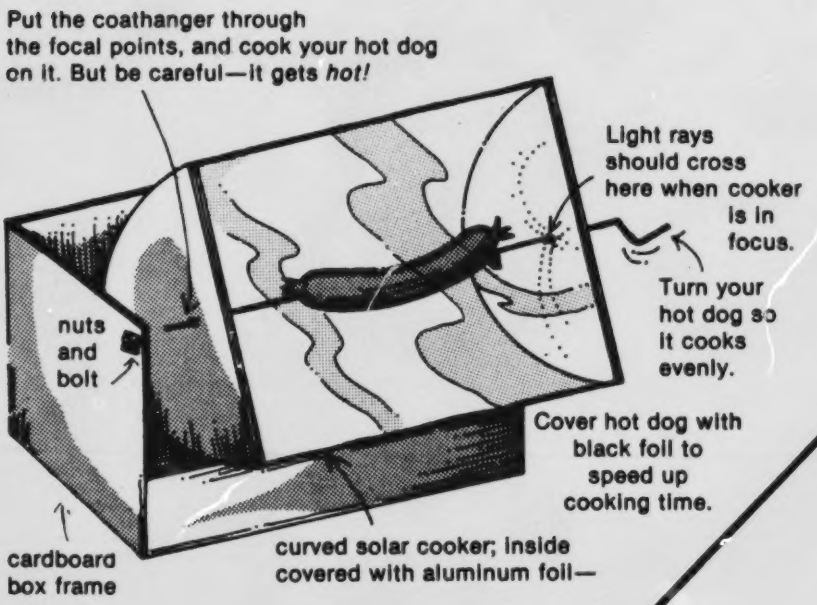

Cut the top and front out of one cardboard box to make a frame for your solar cooker.

Use the pattern on the back to cut 4 pieces from the other cardboard box. Now, glue 2 pieces together to make 1 that is twice as heavy.



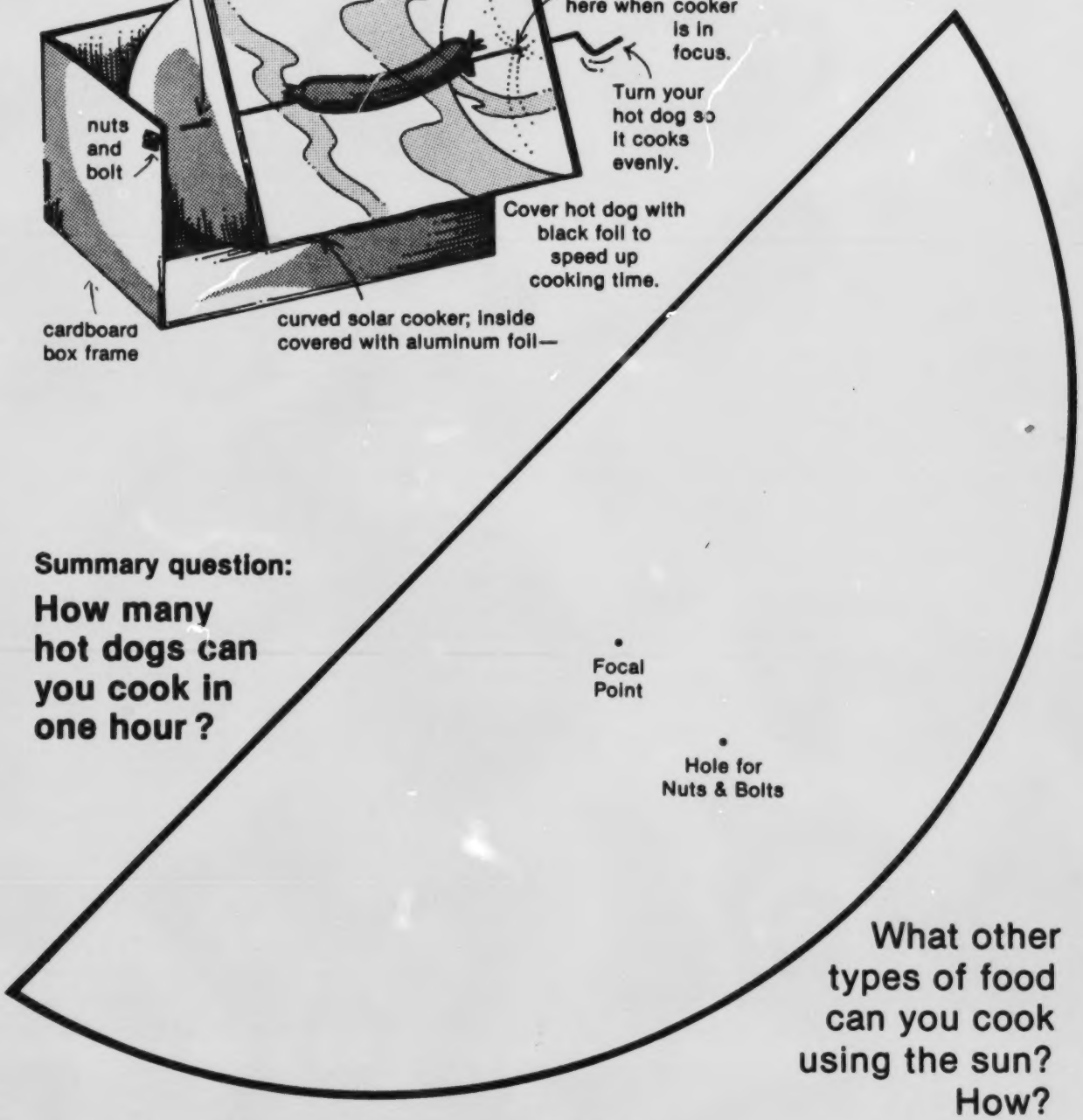

Glue a smooth piece of aluminum foil to one side of the poster board.
Tape the poster board to the two curved pieces.
Attach the cooker to the frame using nuts and bolts.

## Adjust the cooker so that you can see the sun's rays cross on the focal points.


Put the coathanger through the focal points, and cook your hot dog on it. But be careful—it gets *hot!*
Light rays should cross here when cooker is in focus.
Turn your hot dog so it cooks evenly.
nuts and bolt
Cover hot dog with black foil to speed up cooking time.
cardboard box frame
curved solar cooker; inside covered with aluminum foil—

**Summary question:**

**How many hot dogs can you cook in one hour?**




What other types of food can you cook using the sun? How?

**Source** United States Department of Energy

# LESSON #10

**CATEGORY:** Sources

**ENERGY TYPE:** Direct Solar

**TITLE:** Our Best Friend--the Sun

**GRADE LEVEL:** K-2

**INFUSE WITH SUBJECT AREAS:**
Reading
Math
Art

**TIME NEEDED:** Three or four periods

**MATERIALS:**
Various colors of construction paper
Some small objects to place on paper (paper clips, bottle caps, seeds, animal cutouts)
Blindfold
Shoe boxes or small cardboard boxes (2)
Clear plastic wrap
Four thermometers
Tea bags (enough to make tea for class)
Enough pitchers or jars to brew tea for everyone
Sugar to sweeten tea
Some magazines
Timer
Uniformly-sized ice cubes
Sandwich size plastic bags
Metric measuring cup
One paper cup per student
Songs about the sun (optional)

**OBJECTIVES:**

1. The students will understand that the sun is a source of heat and light energy.

2. The students will discover that different colors absorb different amounts of the sun's heat.

3. The students will understand the role of solar energy in producing fossil fuels.

4. The students will be able to give examples showing how the earth receives energy from the sun.

**TASK ANALYSIS:**
The students should be able to work with scissors and tape and be able to fill in information in simple charts.

**PROCEDURE:**

1. Preparation

   Duplicate Student Worksheets 10.12 and 10.13.
   Assemble above listed materials.

2. Steps in Lesson

   Objective #1: The students will understand that the sun is a source of heat and light energy.

a. Read the following story of Icarus and Daedalus to the class. Teachers should note that this is a "real" Greek myth, created many years ago. For a more detailed version, check any source of Greek myths. This version emphasizes the sun and solar energy. Pronounce Icarus (ik' -r s), Daedalus (ded' 1 s).

Icarus and Daedalus

A very long time ago, during the age when Greek art and science were well known, lived a most skillful artist and scientist. His name was Daedalus. Daedalus could do great things and often built things that used energy from the sun. His son, Icarus, was a student who also studied the sun. Icarus hoped to learn much about the sun from his father.

One day, Daedalus was ordered by his King to build a great maze from which no man could escape. Daedalus did this, and the King was very pleased. However, soon after the maze was built, Daedalus fell out of favor with the King. The King feared that Daedalus would try to take over the throne. The King threw Daedalus and his son, Icarus, into the maze, hoping they would never be able to find their way out.

Icarus asked his father, "Father, can you find our way out of this maze?" Daedalus answered him, "Icarus, I made this maze so well, not even I can find my way out."

The two men sat down thinking this was the end. How would they ever be able to get out of the maze? Then, Daedalus had an idea. He jumped up and said, "I know how we can get out."

"We do not have the tools to dig under the maze and make a tunnel to escape but we do have wax from our candles and leaves from the bushes. With this, we can build wings and fly over the walls of the maze to safety!"

Icarus was excited by his father and could hardly wait to start building his wings, "But, Father," he said, "How can we use the wax and leaves to build wings?"

His father answered him, "Using these mirrors that I have hidden from the guards, we can melt the wax for our wings. In the middle of the day when the sun is highest in the sky, we can reflect the sunlight on to the wax from all of our mirrors. When the wax gets hot enough, we can put the leaves into it, forming them into wings. Overnight, the wax will cool and become hard and in the morning, we will be able to fly."

So Daedalus and his son melted the wax that day, made their wings and waited overnight when the sun was not out, for the wax to cool. The next morning, they were ready. Just before leaving, Daedalus told his son to be careful not fo fly too close to the sun.

For if he flew too close, the heat of the sun would again make the wax soft. If this happened, his wings would fall apart and he would drop into the sea.

Icarus agreed with his father. "I will fly close by your side."

Off the two flew out of the trap, over the walls and safely onto the ocean. But they were not free yet. They must still travel a long distance over the sea until they would reach land again. Along the way, the wind began to blow on Icarus, who was much lighter than his father. The wind made him fly higher and higher, although he tried to keep close to his father's side. Closer and closer he flew to the sun. Soon the sun's energy became stronger and stronger, and the wax on his wings began to melt. Suddenly, the wax became so soft that the leaves dropped away. Icarus could not fly anymore and fell into the sea. Sadly crying, his father continued on across, flying to freedom. The sea is now named in honor of Icarus and is called the Icarian sea.

b. After the story, ask students:
--What is a maze? (a place with many passages but only one way leads out)
--What materials did Daedalus use to make wings? (candles, bushes, mirrors)
--What was his energy source to melt the wax? (the sun)
--What made Icarus fall into the sea? (The wind blew him too close to the sun and its heat melted his wax wings.)

c. At a time of day when the sun is shining into the classroom, raise all the window shades for about a minute. Then pull them down for about a minute. Ask the children to describe the difference they observed and name two kinds of energy we get from the sun. (heat and light)

d. On a warm day when the sun is shining in the window, blindfold one student and have another student lead him/her around the room. Have the student being led tell when he/she is in the sunshine and when he/she is not. Ask how the student can tell. (feels heat)

e. Have students do the experiment outlined on pages 10.6 and 10.7 and construct a chart like the one at the bottom of page 10.6.

f. Make sun tea. Fill the pitchers with cold tap water. Put enough tea bags to make tea for the entire class in the water. Put a lid on the jar and leave it in the sun. In about two hours, the tea will be ready to drink. Ask students: How is tea usually made? What job did the sun do? Sweeten the tea if desired and serve it to students. (An option is to make peppermint tea by gathering mint leaves, washing and drying them and adding them to tea as it brews in the sun.)

g. Look at pages 10.8 and 10.9. Do the experiment outlined to answer the question: How much warmer do things get in the sun than in the shade? Have students make and fill in a chart and construct their own graph like the one on page 10.8.

Objective #2: The students will discover that different colors absorb different amounts of the sun's heat.

a. Place different colors of construction paper in the sunlight. Arrange various objects (such as paper clips, bottle caps, seeds and cutouts of animals) on the paper. Leave the objects on the paper in the sunlight for several days. Ask: What happened to the paper? (It faded.) Why did it not fade under the object? (The sun could not reach there.)

b. Study pages 10.10 and 10.11. Do the experiment outlined to answer the question: What color absorbs the sun's heat best? Ask students to explain how the sun's rays have made the ice change.

c. Have students draw a house that would be easy to cool in the summer using what they have learned in the experiment they just did. (It should have a white roof. Some students may think of painting the outside of the house and the room interiors in light colors, of having an overhang to the roof or awnings to shade the windows, of having shade trees and green grass near the house for cooling.)

Objective #3: The students will understand the role of solar energy in producing fossil fuels.

a. Distribute copies of Student Worksheet 10.12. Discuss how the sun plays a role in producing fossil fuels (helps plants to grow, aids in their transformation into coal, oil and natural gas). Use the students' interest and knowledge of dinosaurs to relate how very long ago this change began and how as dinosaurs and plants died, and others grew and died and fell on top of them this caused each layer to press down upon the others, thus changing plant matter into coal and plants and animals into oil and natural gas.

Objective #4: The students will be able to give examples showing how the earth receives energy from the sun.

a. Distribute copies of Student Worksheet 10.13. Discuss examples of how the earth receives energy from the sun and gives off heat (sidewalks, roads, beaches on hot summer days). If the day is warm enough, take children outside and let them feel the heat from these things.

3. Evaluation

a. Some sample questions about the unit might include the following to be answered orally.

—Who wants to tell what happened to Icarus and his father?
—How did the sun help them? How did the sun harm Icarus?
—How did the sun help us to make tea? (It heated the water.)
—Which color absorbs more of the sun's heat (gets warmer), white or black? (black)
—If you want to use less cooling in your house in the summer, what color roof should you have? (white) Why? (It reflects heat back into the air instead of absorbing it into the house.)
—Why is the sun so important in the production of fossil fuels like coal, oil and natural gas? (It caused plants to grow; plants died and fell forming layers of coal; animals ate plants and died and fell forming layers of oil and natural gas.)
—Name two ways you can tell that the earth receives heat energy from the sun and then the earth gives off some of that heat. (Sidewalks, pavement and beaches are warm to the touch.)

b. Make the following bulletin board.

Bulletin Board Idea

After teaching the lesson, have students make a display showing ways the sun gives energy (to make plants grow, heat our homes, light our playgrounds, heat our "sun tea").

4. Follow-Up Activities

a. Sing songs about the sun such as "You Are My Sunshine". Check the school music books and discuss with music teacher. Ask: Why do songwriters have someone be called "my sunshine"? Is this sunshine someone we would like? Students might take a popular song such as "Old MacDonald" and write new lyrics about the sun to the tune.

b. Have students listen while you read the poem "My Shadow" by Robert Louis Stevenson (below), and ask them why the shadow is still asleep before the sun comes up. Let students memorize parts of the poem and recite for the class.

My Shadow

by Robert Louis Stevenson

I have a little shadow that goes in and out with me,
And what can be the use of him is more than I can see.
He is very, very like me from the heels up to the head;
And I see him jump before me, when I jump into my bed.

The funniest thing about him is the way he likes to grow--
Not at all like proper children, which is always very slow;
For he sometimes shoots up taller like an India-rubber ball,
And he sometimes gets so little that there's none of him at all.

He hasn't got a notion of how children ought to play,
And can only make a fool of me in every sort of way.
He stays so close beside me, he's a coward you can see;
I'd think shame to stick to nursie as that shadow sticks to me!

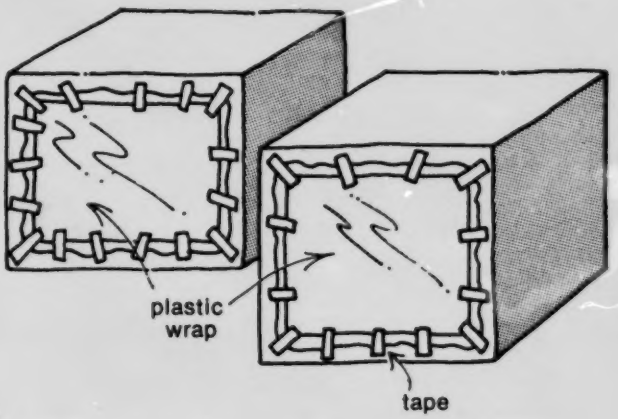
One morning, very early, before the sun was up,
I rose and found the shining dew on every buttercup;
But my lazy little shadow, like an arrant sleepyhead,
Had stayed at home behind me and was fast asleep in bed.

# HOW MUCH HOTTER DOES A HOUSE GET WHEN THE WINDOWS FACE SOUTH INSTEAD OF NORTH?

## MATERIALS:

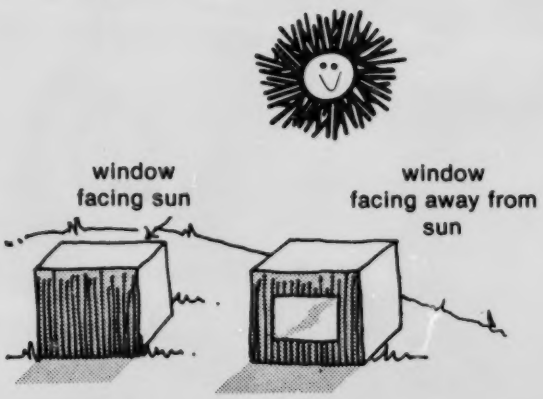
2 Cardboard boxes
(same size)
White paint or paper
2 Thermometers
Plastic wrap; knife
Masking tape

Teacher's Discretion




Cut a large hole in 1 side of both boxes.
Cover holes with plastic wrap.
Tape the wrap tightly over the holes.

Paint both boxes white, or cover them both with white paper.




Place a thermometer in each box. Record the temperature in each box, and put them in the sun.

Record the temperatures after 10 minutes, 20 minutes, and 30 minutes. What do you find?

| Time: | Start | 10 min. | 20 min. | 30 min. |
|---|---|---|---|---|
| facing sun | | | | |
| facing away from sun | | | | |

**Source:** United States Department of Energy

**Summary question:**

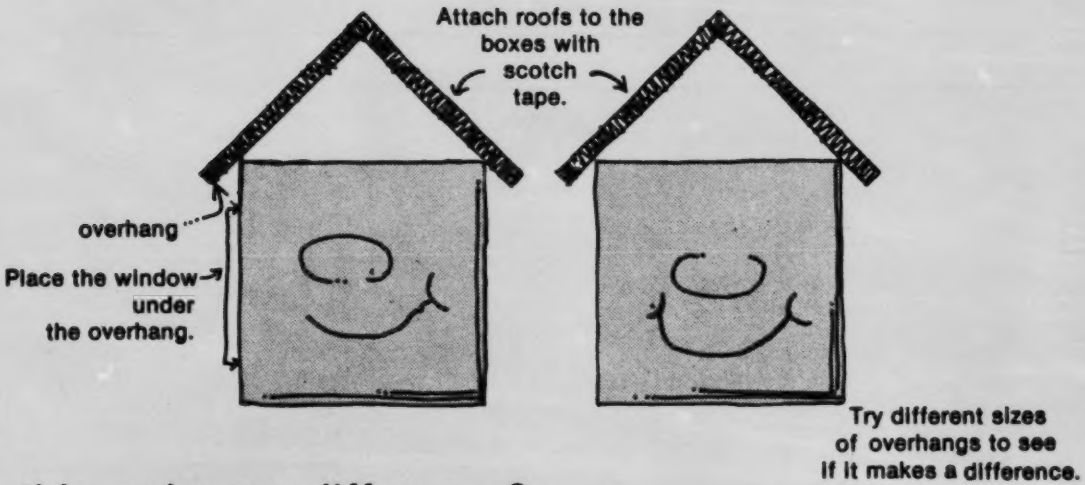
**If you were designing a house in Alaska, on which side would you have the most windows? What about a house in Arizona?**

## OTHER IDEAS TO EXPLORE:

Try this experiment at different times during the day.

Does the time make any difference?

Add an overhang to both boxes.


Attach roofs to the boxes with scotch tape.
overhang
Place the window under the overhang.
Try different sizes of overhangs to see if it makes a difference.

Does this make any difference?
How would the overhang affect the experiment at different times of the year?

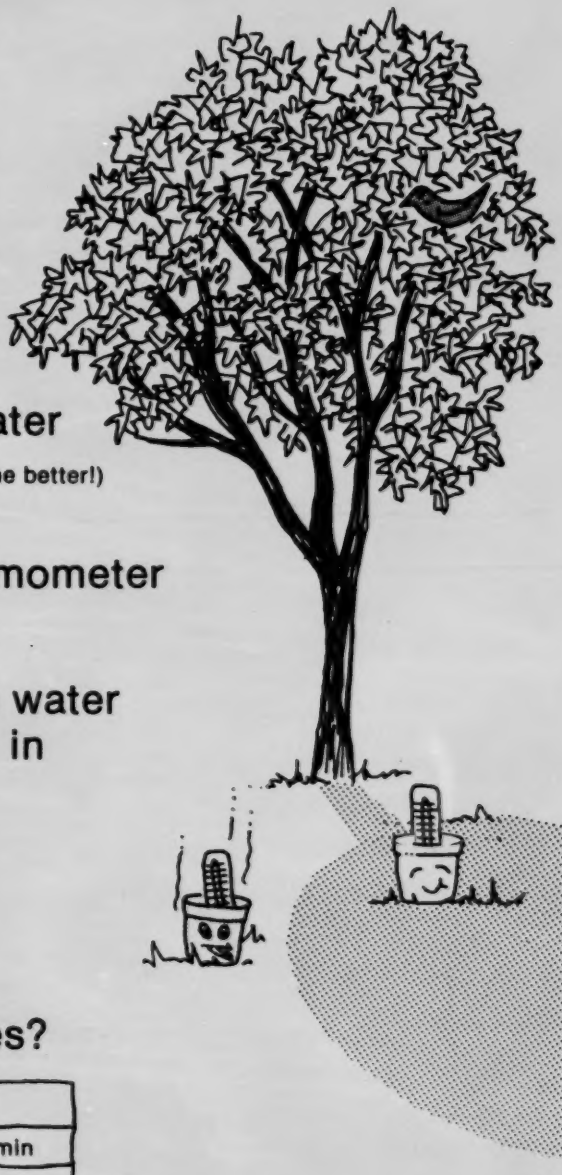


**Source:** United States Department of Energy

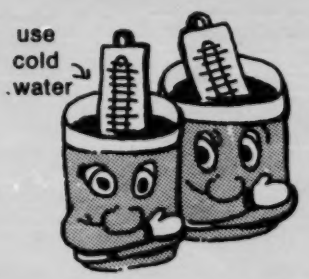
# HOW MUCH WARMER DO THINGS GET IN THE SUN THAN IN THE SHADE?

## MATERIALS:

2 Styrofoam cups
2 Thermometers
Watch



Pour equal amounts of cold water into 2 styrofoam cups. (The colder the better!)




Place a thermometer in each cup.

Measure the water temperature in each cup.

Set one cup in the sun and the other in the shade.

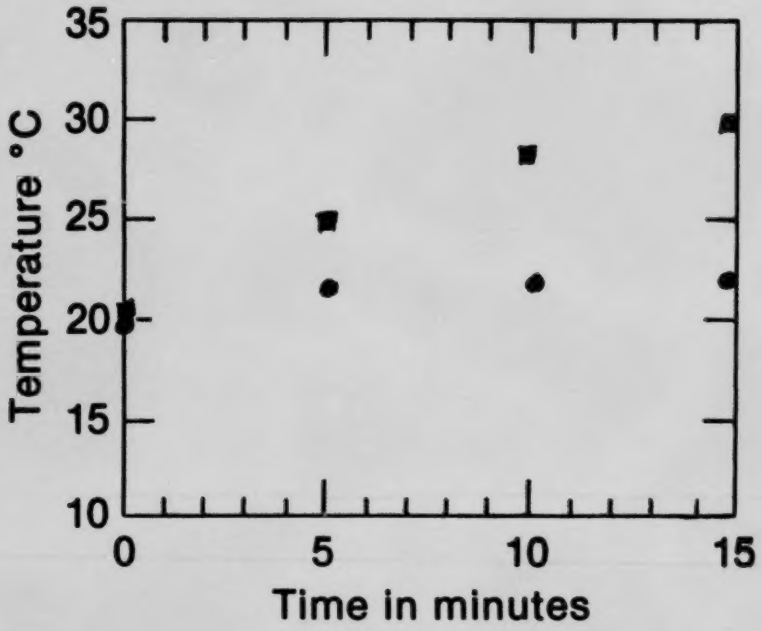
What is the temperature of each after 5, 10, and 15 minutes?

| | Temperature °C | | | |
|---|---|---|---|---|
| | Start | 5 min | 10 min | 15 min |
| | | | | |
| | | | | |

**Source:** United States Department of Energy

Make a graph like the one below, and use it to record the temperatures for 15 minutes. Use different colors for each cup.

Would the water in the cup get warm on a cloudy day? On a cold, sunny day?



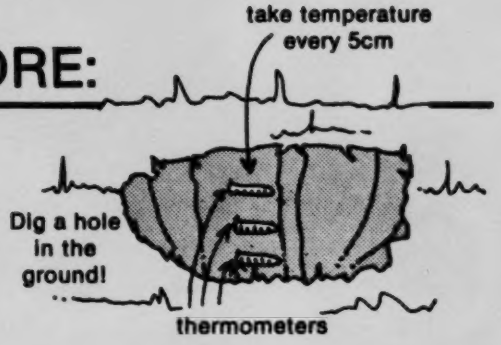

**Summary question:**

**Can a house be heated by solar energy if it is shaded by a big tree?**

What happens to the water in a hose if it lays in the sun all day?

## OTHER IDEAS TO EXPLORE:

What is the difference in temperature of the ground in the shade and in the sun?






**Source:** United States Department of Energy

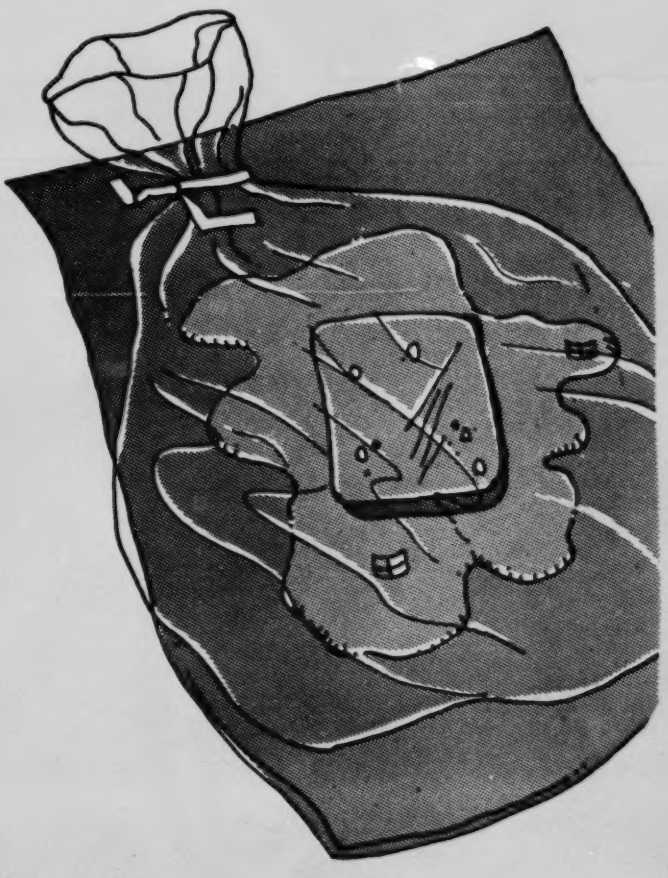
# WHAT COLOR ABSORBS THE SUN'S HEAT BEST?

## MATERIALS:

White, black, green, red, and blue construction paper, all the same size
Timer
Uniformly-sized ice cubes
Plastic bags (sandwich size)
Metric measuring cup

Put an ice cube in a bag. Place a separate cube on top of each sheet of construction paper. Which cube melts first?

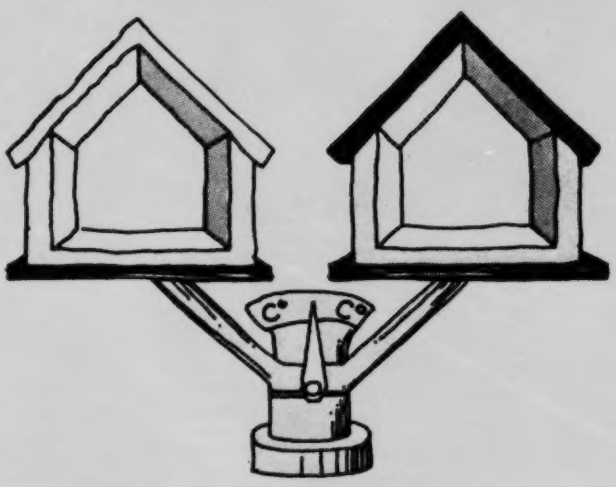
After 20 minutes, measure the amount of water collected in each bag.

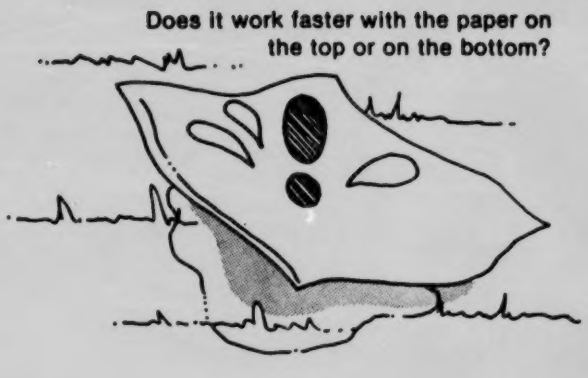


| colors of paper | amount of water collected |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |

**Source:** United States Department of Energy

Would you get the same results if the paper were on top of the ice cubes?






**Summary question:**

**Would a house with a white roof be cooler than a house with a dark roof?**

## OTHER IDEAS TO EXPLORE:

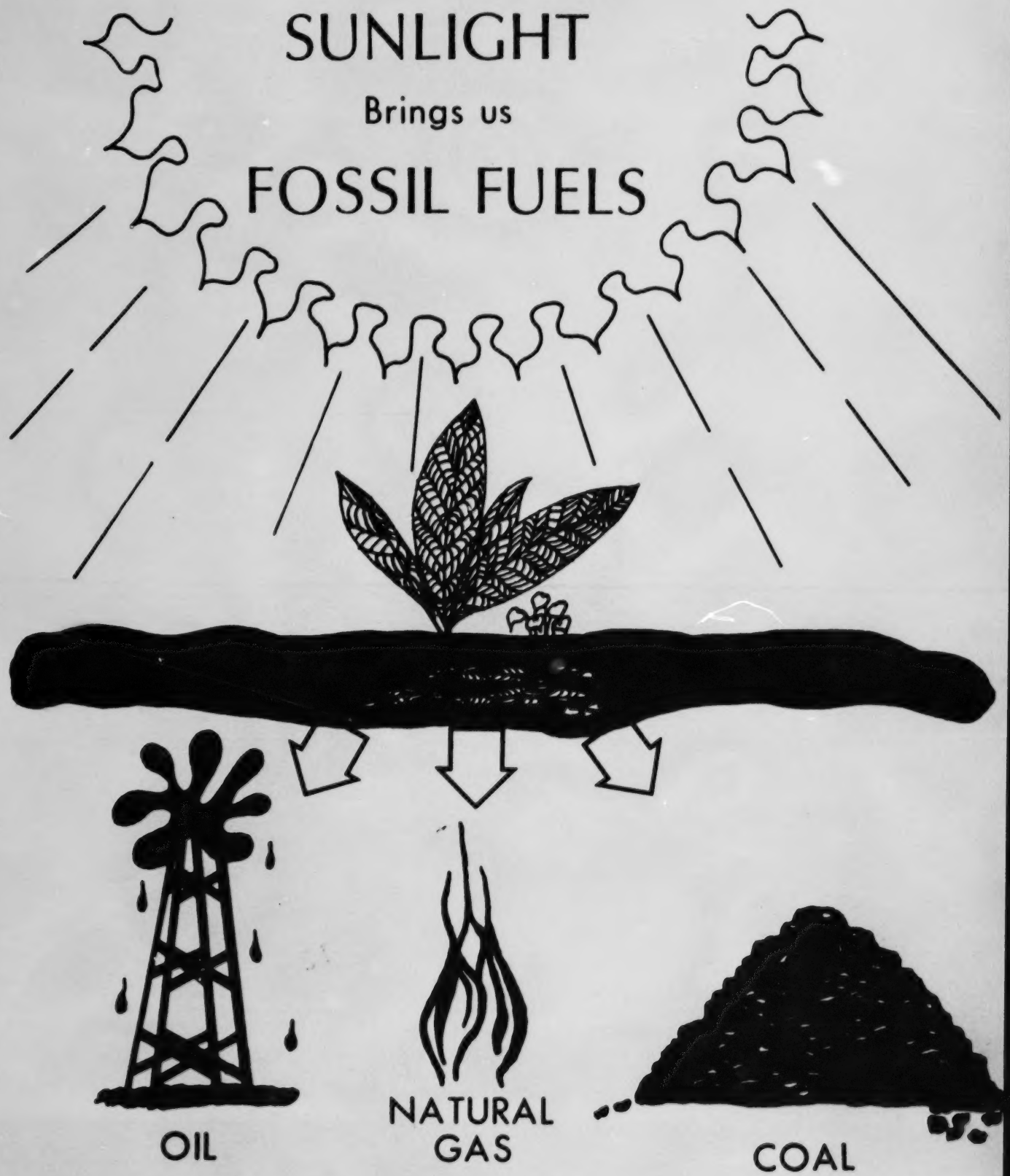
Would a house with a dark roof be more or less expensive to air-condition in the summertime?

**Source:** United States Department of Energy

# SUNLIGHT

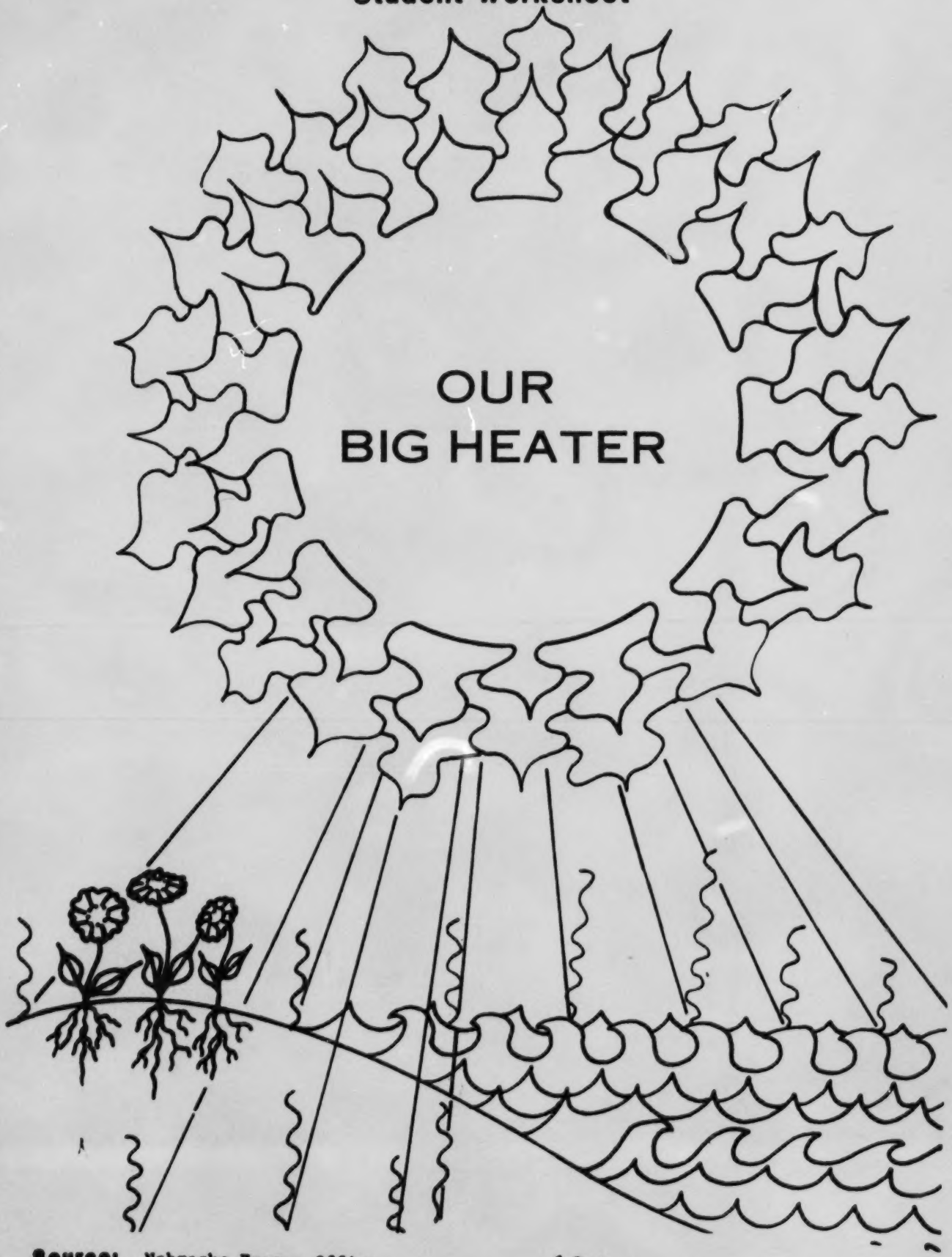
Brings us

# FOSSIL FUELS




Source: Nebraska Energy Office

# OUR BIG HEATER



Source: Nebraska Energy Office

## LESSON #11

**CATEGORY:** Conservation

**ENERGY TYPE:** Direct solar

**TITLE:** Let's Build a Sun Community

**GRADE LEVEL:** 2-3

**INFUSE WITH SUBJECT AREA:**
Art
Math
Science

**TIME NEEDED:** Two periods

**MATERIALS:**

Newsprint
Construction paper
Glue
Crayons
Boxes (small and large)
String
Old clothes
Artifical or real fruit
Plastic wrap
Thermometer
Drinking glass
Access to a refrigerator
Tape
Papertowel tube
Some wire or mesh screen

**OBJECTIVES:**

1. The students will understand some principles of using solar energy to heat homes.

2. The students will demonstrate how storm windows work by making models.

3. The students will learn how the sun's energy can be used to do many jobs in a community.

**TASK ANALYSIS:**
The students should be able to work with scissors and glue, and understand the directions north and south.

**PROCEDURE:**

1. Preparation

   Read Teacher Background Information (11.5-11.8).
   Gather materials listed above.

2. Steps in Lesson

   Objective #1: The students will understand some principles of using solar energy to heat homes.

   a. On a sunny day take the class to a room on the sunny south side of the building. Then go into a room on the shaded north side of the building. Ask the children how the two rooms compare. Elicit the idea that the first room felt warmer because the sun had warmed it.

      Try to get students to reason that in winter, in order to take advantage of the sun's heat, large windows should be on the south side with smaller and fewer windows on the north.

Ask: Will the room be warmer if you leave the curtains open on a sunny wintry day? (Yes) What about on a dark cloudy wintry day? (No) Closing the curtains on a dark winter day helps keep the cold air out.

b. Have students plan and build shoe box houses which can utilize the sun's heat for heating in winter. Place the houses near the window in a sunny room. Discuss with the children how the houses should be oriented. To test their hypothesis, several houses should have the large windows facing away from the sun. Small dishes of water placed in the houses could be checked for temperature change to demonstrate that houses with windows facing the sun hold more heat. (Note: The roof overhang is also important to keep hot summer sun out of the windows.)

Keep the houses to use later in this lesson.

Objective #2: The students will demonstrate how storm windows work by making models.

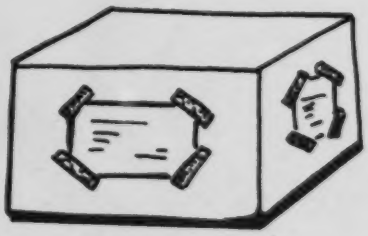
a. Cut four large "windows" in a cardboard box. Put one window on each side of the box. Tape a piece of plastic over each opening (on the inside of the box.)

b. Fill a glass with tepid water, insert a thermometer, and place it in the box.

c. Place the box in the refrigerator and check the temperature every three to five minutes for an hour. Record the findings.

d. Add "storm windows" by placing the plastic wrap over the outside of the openings, thus doubling the windows. Pull the plastic tightly. Fill glasses with tepid water again, bring thermometer to the same level as before.

e. Place the box in the refrigerator again and check the temperature at the same intervals. Compare results of the two experiments and ask students to explain.



Objective #3: The students will learn how the sun's energy can be used to do many jobs in a community.

a. A "Sun Community" is a town or city which is using the sun's energy to do clean, efficient jobs like heating homes, growing vegetables, drying clothes, baking food and drying fruit. You do not have to live in a sun community to use the sun's energy. Tell students: Let us pretend that you can build your own community. Help the sun do its job by building houses that face south and have storm windows, light colored roofs and overhangs, and by building clothes lines, greenhouses, solar hot dog cookers (see Lesson #9 for directions) and food dryers (see Figure 2 on this page).

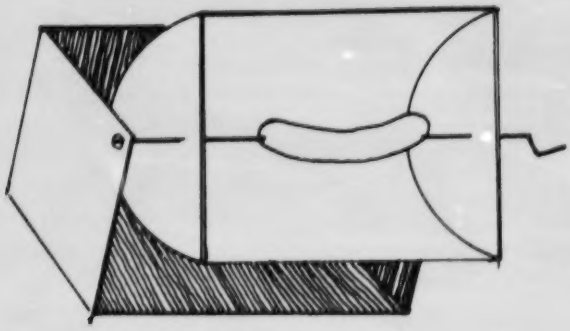


Figure 1. Solar Hot Dog Cooker

b. You can dry fruit using solar energy!
Dried fruit can be stored for long periods of time without losing its food value. However, dried fruit can be more expensive per pound than fresh fruit. Many fruits and vegetables including raisins, prunes and parsley are sun-dried commercially.

Make an incubator with shelves. Place the fruit on the shelves. Put the incubator in an attic or warm closed area. Record the time it takes to dry the fruit.

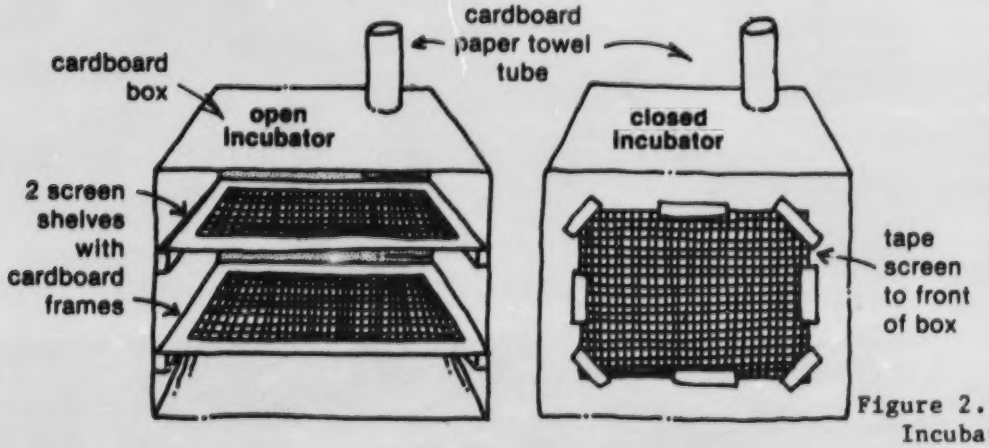



Figure 2. Incubator

Source: United States Department of Energy

3. Evaluation

Observe student participation and enthusiasm in building the sun community. Students should show their understanding of the lesson by building houses that will make efficient use of the sun's heat energy and by building other devices that will use solar energy.

4. Follow-Up Activities

a. Visit a home which uses storm windows or, if possible, one which uses solar energy for heating.

b. Take students on a walk around the community and have them notice whether or not the homes they see take advantage of solar energy by having large windows on the south, by having storm windows and doors, by having clotheslines outdoors, etc.

Source:

Paul L. Butt. Arkansas and Energy. Arkansas Ecology Center: Little Rock. 1979.

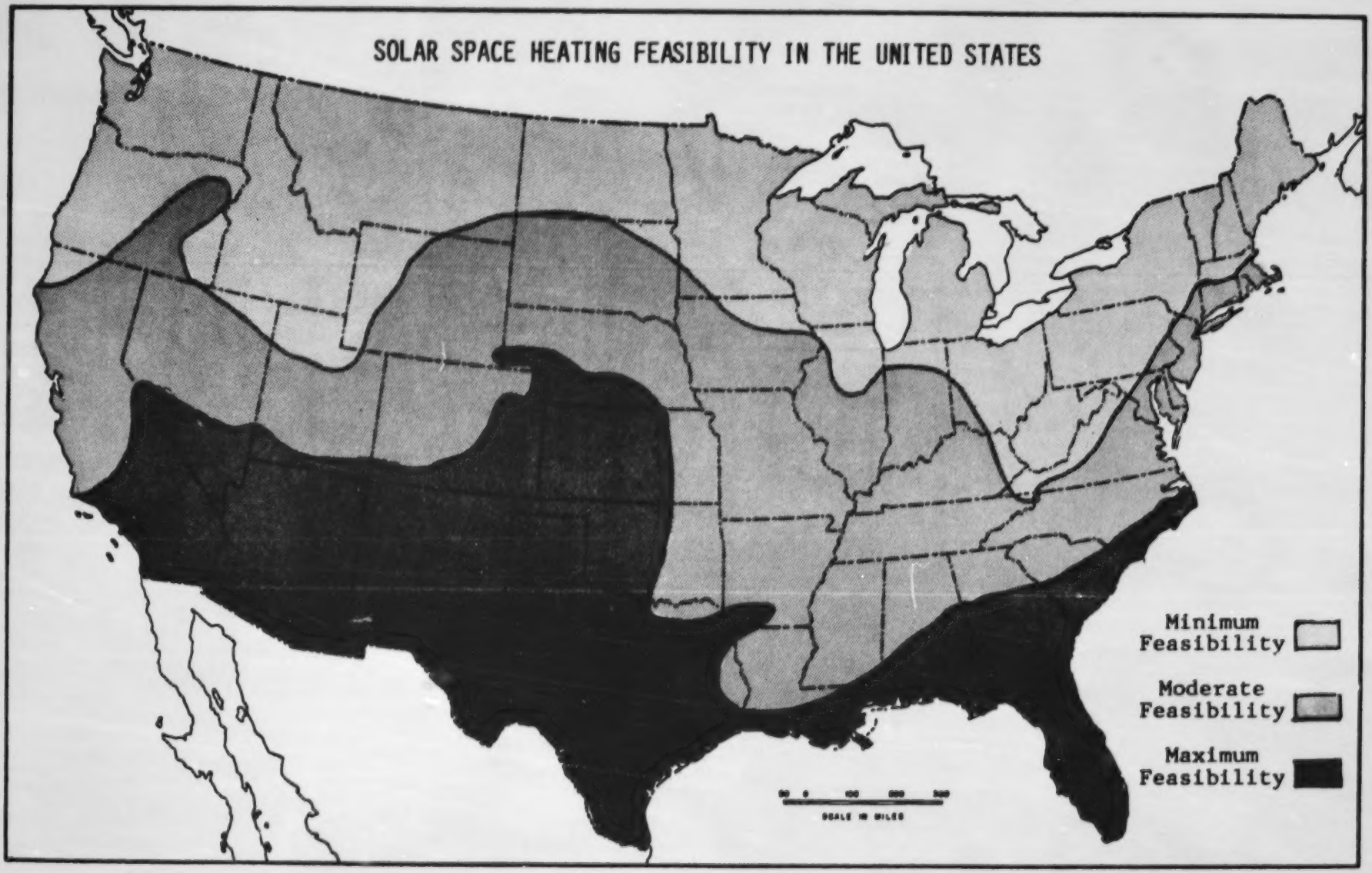
## Direct Solar Energy: Milking Sunbeams

To harness direct solar energy, the sun's radiation is collected and concentrated and then used for hot water heating, space heating, and space air conditioning, or converted to electricity using solar cells. Direct solar energy has an impressive array of advantages over other energy sources. It is an essentially unlimited and readily available energy source. The amount of solar energy that reaches the earth's surface in two weeks is equivalent to the energy in all known fossil fuel reserves. Direct solar is the cleanest and safest of all energy sources. With solar energy the major release of heat occurs in the sun, thus avoiding heat build-up in the atmosphere. No major breakthroughs are needed to make direct solar energy technologically feasible. The major impediment at present is its economic feasibility--or at least its perceived economic feasibility.

Along with its many advantages, direct solar energy has some problems. The solar energy falling on the earth's surface is so widely dispersed that collecting and concentrating it present difficulties. Concentrating it slightly to heat water and buildings is sensible, but concentrating it to high-temperature heat yields negative net useful energy. Or to say it another way, more energy (and money) has to be put into the system than can be gotten out. Like most dispersed, or decentralized, energy technologies, direct solar energy is resource intensive (copper, aluminum, glass). The mining, transportation, and refining of these materials all entail some negative environmental impacts. There is a price associated with every energy alternative. Even the technologies used to capture solar energy do not offer a "free lunch."

Another problem is that the supply of direct solar energy varies with weather and climatic conditions. In some areas solar energy can provide essentially all space heating needs, while in other areas only part of these needs can be met with solar. The figure on page 11.6 shows the direct solar space heating feasibility in the United States. In the darkest areas, homes can be heated entirely by solar energy; in the light gray areas, solar energy can provide a large portion of the heat; in the white areas, only a small part of the space heating can be provided by solar energy.

Throughout northern Arkansas solar energy can provide 60 to 80 per cent of the residential space heating requirements. Throughout the southern half of the state solar can provide 70 to 100 per cent of the home space heating needs. In the extreme southwest area of Arkansas (see Page 11.6), the entire residential space heating need generally can be provided by solar energy. The fuel (sunlight) is free, but the collecting and backup equipment can be quite costly initially. But in terms of lifetime cost, direct solar energy is economically attractive in Arkansas. This long-term economic advantage will increase as fossil fuel and nuclear power prices rise.


SOLAR SPACE HEATING FEASIBILITY IN THE UNITED STATES
Minimum Feasibility
Moderate Feasibility
Maximum Feasibility

II.6

## Passive Solar Systems

Direct solar energy can be utilized by either passive or active systems. A passive solar heating system uses solar heat directly and is the simpler method to use. A passive system relies upon natural energy flows and upon a building's design, composition, and site to capture and store the solar energy rather than upon a mechanical array of fans, pumps, and special collectors. A typical passively-heated house is tightly constructed and well insulated, with structural components throughout that are massive in order to retain heat, and with double-glazed windows on the south side and few (if any) windows on the north. The south-facing windows also have an overhang which permits the low sun to enter in the winter but does not permit the high summer sun to enter. Easily movable insulating panels cover the windows at night to retard loss of the heat stored in the building's walls and floors during the day. During hot weather the panels are closed during the day and opened at night.

Passive solar heating is adapted to use in Arkansas where the winter temperatures are generally not too extreme. Other passive solar approaches suitable for use in Arkansas include reducing temperature variations by storing the solar energy in special south-facing, heat-storage walls, composed of concrete, rocks, water-filled barrels, or anything which is capable of storing large amounts of heat; and attaching a greenhouse to a building to serve as a solar collector as well as to grow plants.

Passive systems can be used in new construction or a home can be "retrofitted" with a passive system. Many Arkansas architects are now becoming active in drawing plans to take passive advantage of abundant solar energy. Some of these architects' designs are modern in nature and the construction cost is greater than the cost of a conventional home. Therefore, their designs make passive solar construction appear more expensive than necessary. Unfortunately, the majority of the architects who are well grounded in designing passive structures are in the educational field and do few designs for clients.

If a house is to be newly constructed and the plans are chosen carefully, adding passive solar energy should add no more than ten per cent to the original cost of the structure. Using a well-designed passive system, an Arkansas homeowner can save from 80 to 90 per cent of his heating costs and also substantially cut his cooling costs. Passive solar energy is now used to provide part of the space heating for several hundred homes in Arkansas according to a 1980 Arkansas Department of Energy estimate.

In addition to the residential sector, passive solar heating also has applicability to commercial, industrial, and agricultural buildings. The University of Arkansas farm in Fayetteville is operating a poultry house heated primarily with passive solar techniques instead of the customary propane. It is intended to serve as a model for the entire poultry industry of northwestern Arkansas.

Passive cooling is possible in some parts of the United States, but in Arkansas the humidity is too high to make this feasible. In northwestern Arkansas, the higher altitudes and the reduction of humidity make it possible to use natural ventilation for cooling.

## LESSON #12

**CATEGORY:** Conservation

**ENERGY TYPE:** Coal, Oil, Natural Gas and Electricity

**TITLE:** Conservation Is the Key

**GRADE LEVEL:** K-3

**INFUSE WITH SUBJECT AREA:**
Language Arts
Art

**TIME NEEDED:** One period

**MATERIALS:**
Crayons
Pencils
Cellophane tape
Plastic food wrap (for follow-up activity)

**OBJECTIVES:**

1. The students will understand the meaning of "conserve".

2. The students will be able to spell "conserve". (Grade 3)

3. The students will recognize conservation measures being used in each picture of the Student Coloring Book.

**TASK ANALYSIS:**
The students should be able to copy sentences from the chalkboard.

**PROCEDURE:**

1. Preparation

   Read Teacher Background Information (12.4).
   Duplicate Student Worksheets 12.5-12.11 and staple 12.5-12.10 into booklets.
   Assemble materials listed above.

2. Steps in Lesson

   Objective #1: The students will understand the meaning of "conserve".

   a. To develop the meaning of "conserve", ask students:
      --What would happen if we used all our coal, oil and natural gas? (We would have to find other forms of energy or we would be cold and hungry.)
      --If we use less coal, oil and natural gas now by not wasting it, will we have some later to use? When we save energy by using less coal, oil and natural gas, we say that we "conserve" it.

   b. Have the class pronounce "conserve". Then ask:
      --What consonant sound do you hear at the beginning of the word? (c) At the end? (v) In the middle? (s)

c. Ask several students to come to the chalkboard and write sentences using the word "conserve" (Grade 2). Or have students talk about ways to "conserve" while you write their ideas on the board (Grades K-1).

Objective #2: The students will be able to spell "conserve". (Grade 3).

a. Ask students to find "conserve" in the dictionary and have them write a definition at the top of their paper.

b. Then ask them to draw an illustration for the word showing how people can conserve energy. Assign the word as part of their weekly spelling lesson.

Objective #3: The students will recognize conservation measures being used in each picture of the Student Coloring Book.

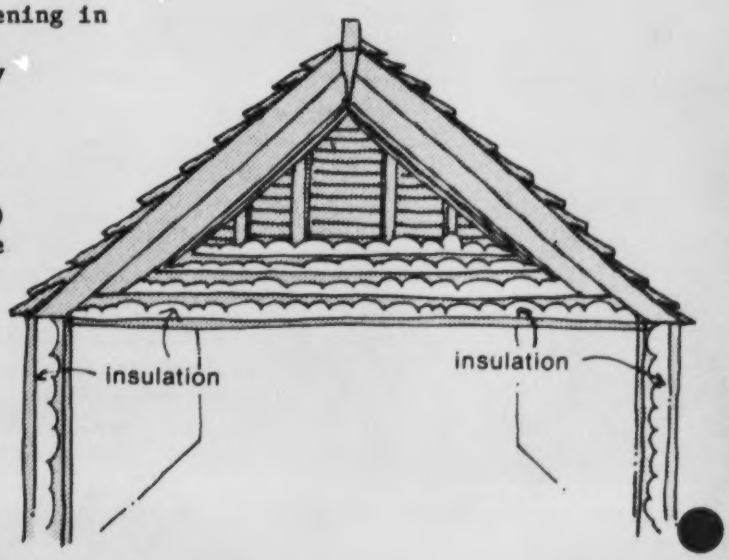
a. Distribute copies of the coloring book made up of Student Worksheets 12.5-12.10 titled "Energy Can Be Conserved". Ask: What does the title say? What does it mean? (Energy can be saved.)

b. Page 12.6--Ask: What is shown in this picture? Where might these people be going? How else could they get where they are going? Do people save energy by using bicycles rather than cars? What form of energy do you use when you ride a bike? (Muscles fueled by food) Which form of energy do you use when you ride in a car? (Gasoline) Have students make up a sentence describing the picture and help them write their sentences at the top of the page.

c. Page 12.7--Ask students to describe what is happening in this picture. Ask: When do we need the lights on? When should we turn them off? Help students write a sentence at the top describing the picture.

d. Page 12.8--Ask: What is happening in this picture? How warm should we keep our homes and school? What can you do to keep warm without increasing the heat? (Wear more clothing.) Help students write a sentence to describe the picture.

e. Page 12.9--Ask: What is happening in this picture? How are storm windows useful? Are there any other things around a house that we can do to keep our homes warm in winter and cool in summer? (Insulation in walls, attic and under floors) Help students write a sentence to describe the picture.



f. Page 12.10--Ask: How are these people saving energy? (By carpooling) How else might they get where they are going? (By riding bicycles, walking or by using mass transit) How are the children in sweaters saving energy? (Dressing in warmer clothes allows us to turn thermostats down which saves energy.) Do you know any other ways to save energy? Help students write sentences at the top telling ways to save energy.

g. Allow students time to color those parts of the book they want to color.

3. Evaluation

a. Include "conserve" on weekly spelling test (Grade 3) Ask students to write a sentence using the word "conserve".

b. Distribute copies of Student Worksheet 12.11 and explain that there are two pictures in each set--one showing a way to save energy and one showing a way to use more energy. Have students check the pictures which show how to "conserve" energy. Then have them draw their own set of pictures in the blank boxes. After they have finished, discuss their answers as you check.

c. Oral evaluation: Ask students to name at least three ways to conserve energy.

4. Follow-Up Activities

Let students test for drafts around windows and doors in the classroom using the draftometer described on page 12.12. Explain to students that in order to conserve heat and keep it from escaping, these air leaks should be plugged up.

Sources:

Paul L. Butt. Arkansas and Energy. Arkansas Ecology Center: Little Rock. 1979.

United States Department of Energy. Science Activities in Energy. United States Department of Energy: Washington, D.C. 1980.

If the energy consumption habits of Arkansans are reflective of those of the nation, about half the energy used in Arkansas is wasted. In fact, the cheapest source of energy avilable today is that of conservation. Technically, conservation is not a source of energy, but since it reduces the use and waste of energy resources it will be referred to as such.

It is cheaper to save a barrel of oil than to produce an additional barrel. One projection indicates that turning all thermostats in the United States down two degrees in winter and raising them two degrees in summer could save more than half a million barrels of oil a day.

Dwindling of existing resources--coal, petroleum, natural gas--and excessive financial and environemental costs of developing new sources of energy are twin problems facing the United States and other nations of the world.

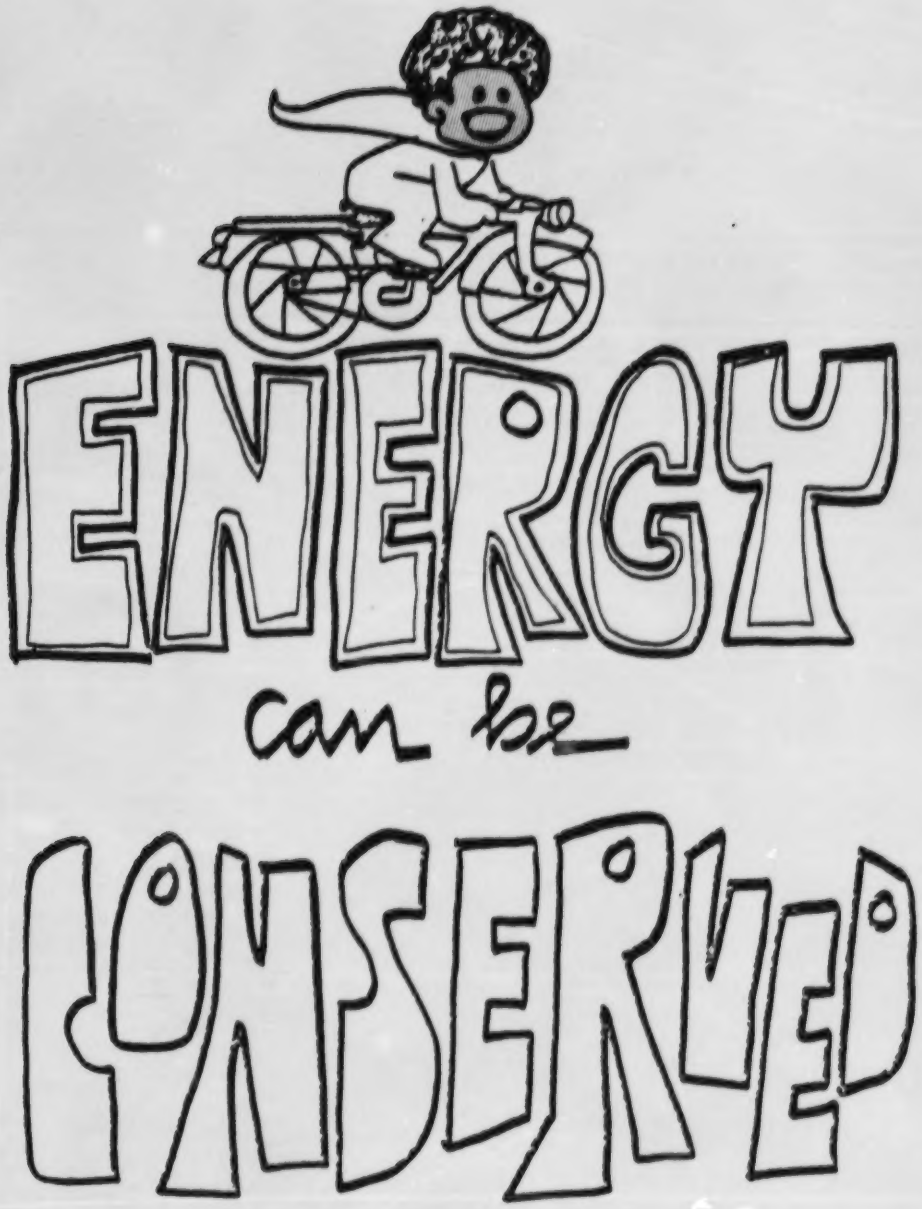
Conservation has more immediate results than new resource development, too. It takes five years to bring a new coal mine to full production, six to seven years for a new oil field, and ten to twelve years for a nuclear power plant.

In 1980 with 5 1/2 per cent of the world's population, the United States consumed about one-third of the world's energy. On a per capita basis, West Germany used only 20 per cent of the gasoline the United States did, and Sweden used half as much as the United States in total energy. All three nations have comparable standards of living.

Personal use of energy in this nation--home heating, lighting, air-conditioning, cooking, refrigeration, and transportation--accounts for 37 per cent of the nation's energy use. In Arkansas, since much of the population is sprawled about the counbtryside, transportation alone accounts for nearly 30 per cent of the total energy consumed.

It is not necessary, however, for Arkansans to give up the family car. What is necessary is that the car go twice as far on a gallon of gasoline. And that the car, as often as possible, carry more occupants than merely the driver.

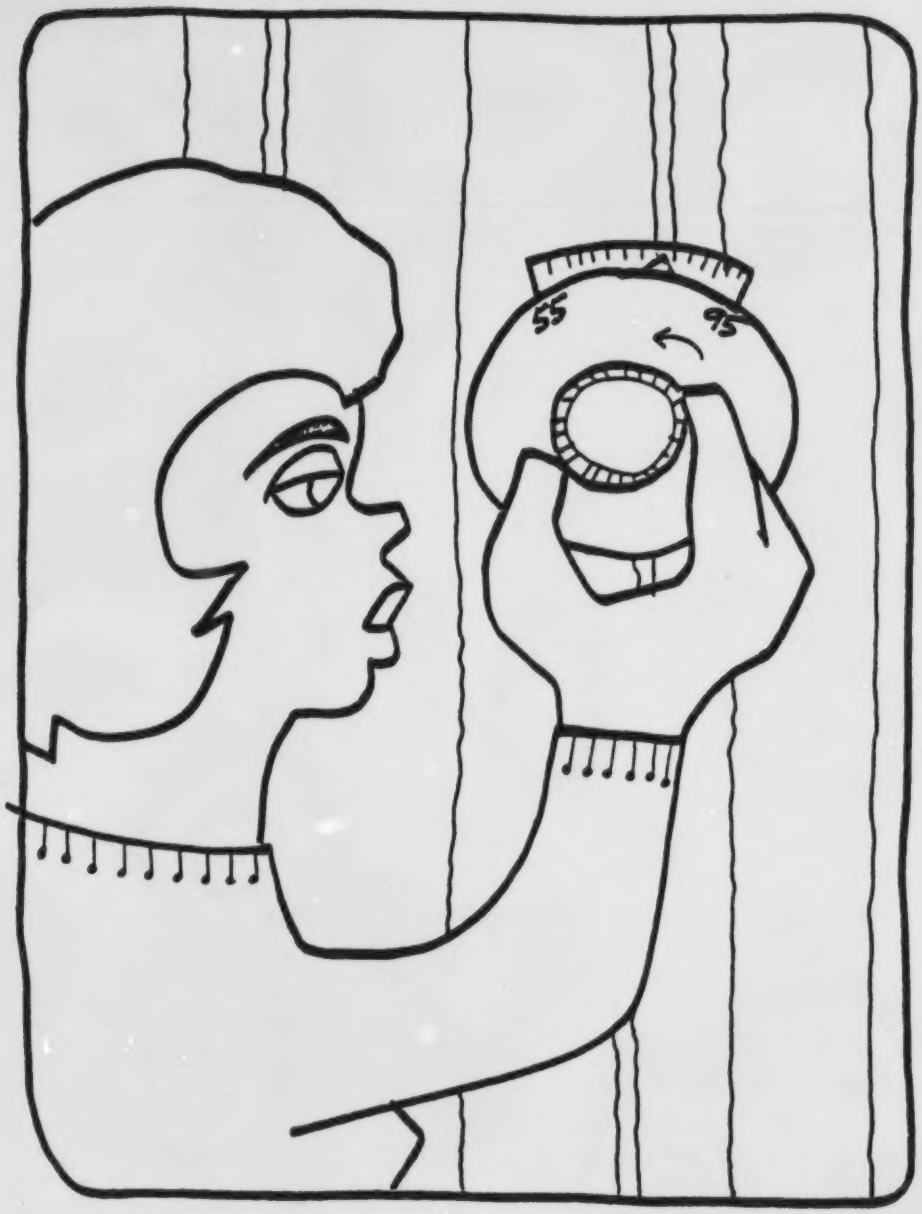
Residential energy use accounts for about 15 per cent of the total energy (including electricity) consumed in Arkansas. The national percentage is about the same. Houses in Arkansas typically consume about 40 per cent more fuel each year for heating and cooling than is necessary. A booklet entitled The Arkansas Energy Saving Handbook for Homeowners by James Morrison may be obtained by writing the Arkansas Energy Office, 3000 Kavanaugh Boulevard, Little Rock, Arkansas, 72205, or by calling their toll-free hotline (1-800-482-1122). Many pamphlets are available upon request dealing with conservation in the home, on the job and on the road.






**Source:** Oklahoma State Department of Education

ON
OFF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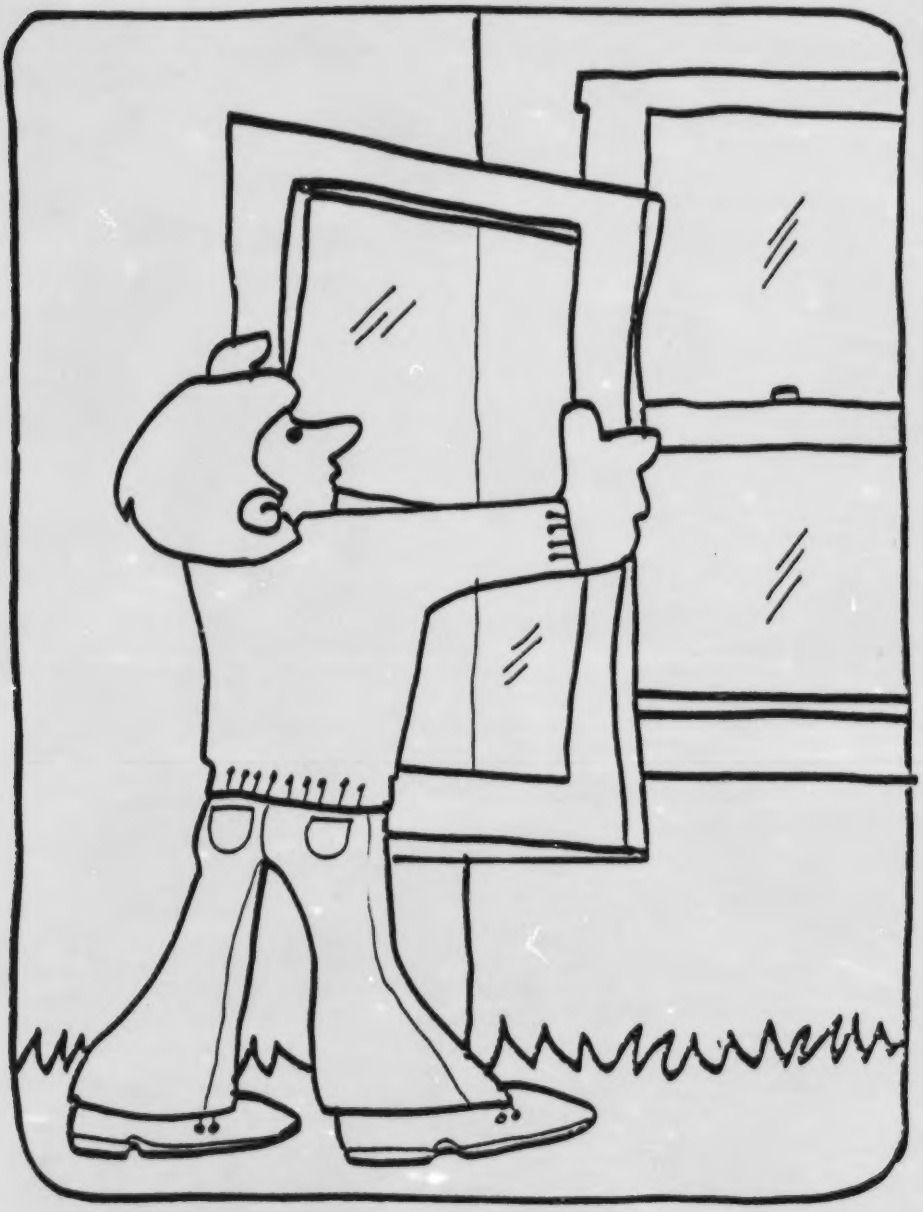
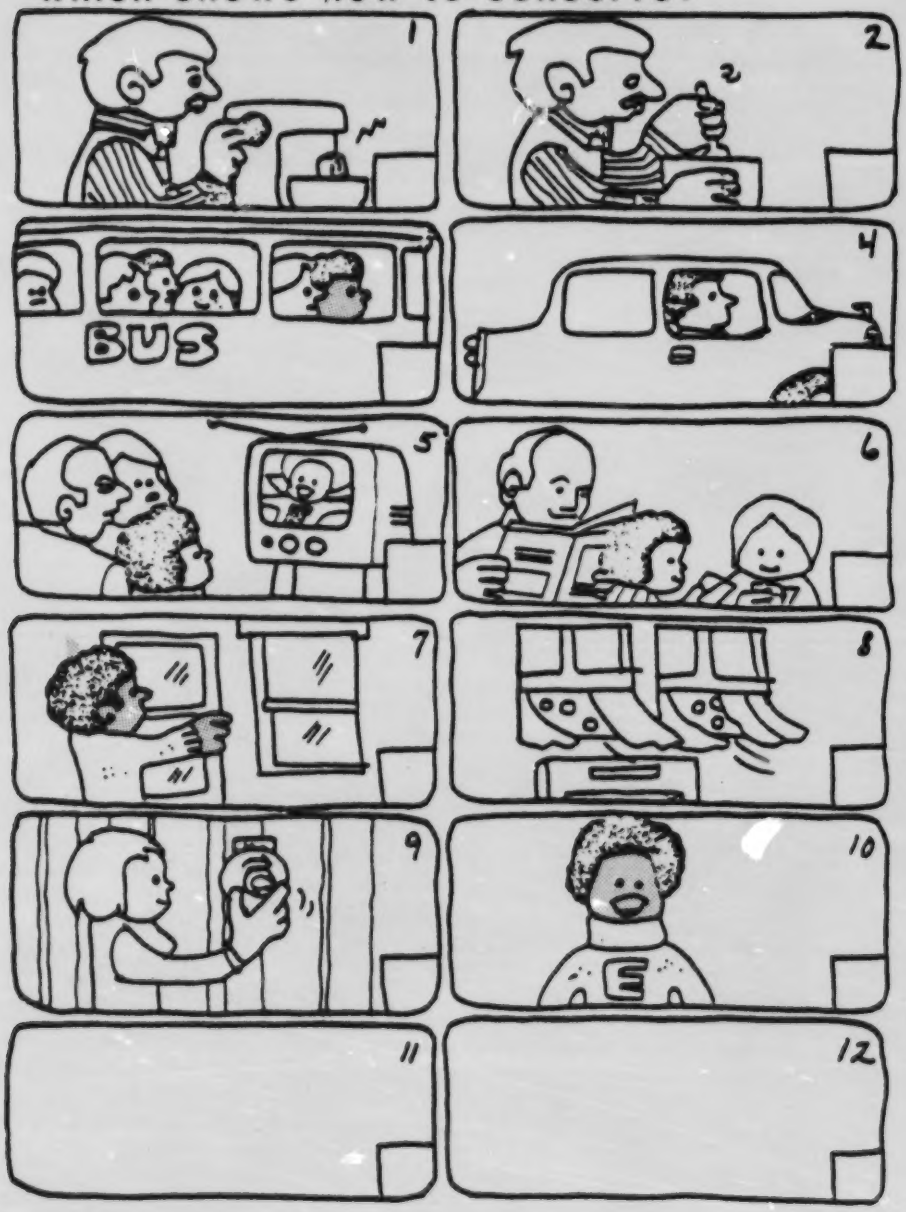


## Student Worksheet

Conservation Checklist

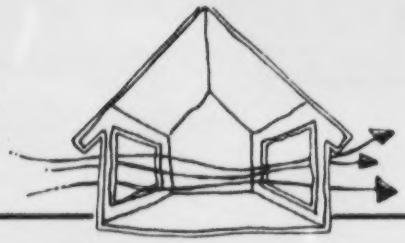
**Check the picture in each pair which shows how to conserve:**






**Source:** Oklahoma State Department of Education

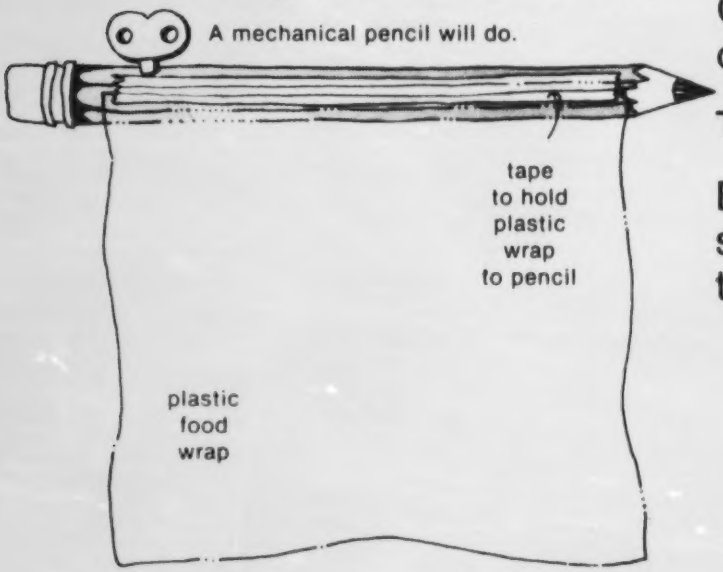
# IS YOUR HOUSE DRAFTY?



## MATERIALS:

Pencil (a long strip of poster board works well, too)
Scotch tape (double-stick tape is handy)
Plastic food wrap

Make a draftometer by following these instructions:

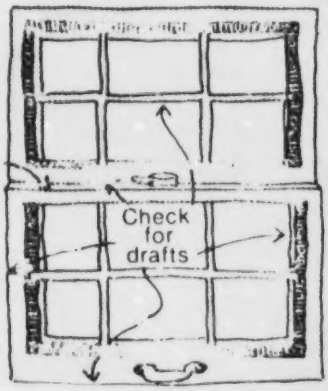



NOTE: Forced air furnaces must be off to use draftometer or you'll get false drafts.

Cut a 12-cm by 25-cm strip of plastic food wrap.

Tape the wrap to the pencil.

Blow the plastic gently and see how freely it responds to air movement.




Test your home for air leaks by holding the gadget near the edges of windows and doors.

**Source:** United States Department of Energy

LESSON # 13

**CATEGORY:** Conservation

**ENERGY TYPE:** All

**TITLE:** Willie the Waster

**GRADE LEVEL:** K-3

**INFUSE WITH SUBJECT AREA:**
Math
Social Studies
Language Arts

**TIME NEEDED:** One period

**MATERIALS:**
None

**OBJECTIVES:**

1. The students will examine values and attitudes toward energy conservation in order to establish a priority in their lives for energy conservation.

2. The students will apply their knowledge of energy waste to their own everyday lives.

**TASK ANALYSIS:**
The students should understand the meaning of "waste"; and understand what is meant by energy shopper, energy consumer, energy disposer, energy product and recycling.

**PROCEDURE:**

1. Preparation

   Duplicate Student Worksheets 13.5-13.11.
   Introduce the following terms: energy shopper, energy consumer, energy disposer, energy product, and recycling.

2. Steps in Lesson

   Objective #1: The students will examine values and attitudes toward energy conservation in order to establish a priority in their lives for energy conservation.

   Objective #2: The students will apply their knowledge of energy waste to their own everyday lives.

   a. Ask students to think about products they waste every day. They may waste food by not eating it and throwing it away. They may waste paper or crayons by only using a little bit and then throwing them away. Put the word "waste" on the chalkboard. List students' examples under it. They should see that waste is a part of their everyday lives, and involves poor use of things. Ask them to compare the ways they waste products to a list of ways to save products such as: repairing the pencil sharpener instead of throwing it away, peeling the paper off crayons to keep using them, and turning notebook paper over to use the other side.

b. Talk with students about how they also waste "energy products" (anything made from an energy source and requiring energy for its production). Use the list you made on the chalkboard to talk with students about how some of their items in the list in Activity (a) involve wasting energy products (i.e. paper). Add some items that students suggest that involve wasting energy products. (Electrical appliances are energy products and are often used in a wasteful manner.)

c. Help students to more fully see one way that they waste energy products--they throw away things they could use, or others could use again. Explain to students that food can be saved, as can crayons.

Other items can be recycled. Used paper can be reused if it is collected, processed, and made into new paper. The same is true of cans and bottles. Ask students to bring in one item from home that can be recycled. (It might be a good idea to bring some samples from your own home in case they forget.)

**MATERIALS WHICH CAN BE RECYCLED. . .**

When students bring their items to class, talk with them about how they waste these items, and how they can be recycled. You may want to have someone from a recycling center come to class to talk about what is recycled, how it is done, and how important it is to the community. (See list of Arkansas recycling industries on page 13.12.)

d. Ask students to draw pictures or act out ways they waste an energy product and how it can be saved or recycled.

e. Now read, or ask students to read aloud, the cartoon strip on "Willy the Waster". (Student Worksheets 13.5-13.7) The cartoon strip indicates how people waste energy products in all their consumer roles: as shopper, user and disposer of energy. Tell them that there are instances in the cartoon strip in which energy products are wasted in each of these roles. Have them speculate about how energy products are wasted, and then have them answer the following questions:
   --In what ways did Willy waste energy products as a shopper? (He chose George the Can without thinking about the contents.)
   --How did Willy use energy products wastefully? (He did not drink all of the contents of George the Can.)
   --How did Willy dispose of energy products wastefully? (He did not dispose of the can in a place where it could be reused or recycled, or one that was safe.)

f. Students should then study the Energy Waster Questions (Student Worksheet 13.8). It is divided into three parts, including shopper, user and disposer roles. The list should include a set of questions which pinpoint energy waste.

   After distributing Student Worksheet 13.8 to the class, discuss the questions with students. See if they think they cover all the dimensions of possible energy waste for them, and for their community. Add or substitute questions developed by students. One addition might be: Is this product wrapped in more paper (boxes, cellophane, etc.) than is necessary?

g. Students should then give themselves a self-check in class, as small groups, or as individuals on the Energy Waster Questions. They should take a type of energy or an energy product, such as electricity, cars, home heating or school lighting, and determine answers to the questions. Do they really need to use lights? Is it best to use all the lights all the time? They should continue with these questions and determine whether or not there is wastage in the areas of shopping, using or disposing of energy or energy products they have selected.

h. Now ask students to select one type of energy or energy product they think they use a lot (e.g. food, family car gasoline). They should get information (self-reports, observation, a log) about their use of this type of energy. They should then determine answers to the Energy Waster Questions again.

When students have collected their answers, discuss them in class using the following questions:

--What energy did you waste?
--How did you waste that energy? (while shopping, using or disposing)
--How can you try to save energy? (recycling, using again, using less, using less often)
--Why is saving this energy important? (saves money, saves energy for everyone)

i. Ask students to try to be more careful of energy based on their answers to question #3 above for one week. Talk with them about their progress in saving this energy.

3. Evaluation

a. Use student response to parts (g) and (h) of the lesson to assess effectiveness of the lesson.

b. Have students unscramble the answers to fill in the blanks on Student Worksheets 13.9-13.11. (Answers are: without, cut back, alternative.)

4. Follow-Up Activities

a. Language arts: Have students use puppets to talk about a specific energy product they waste and how it could be saved.

Devise a spelling test based on some of the terms used in the lesson. (Grades 2-3)

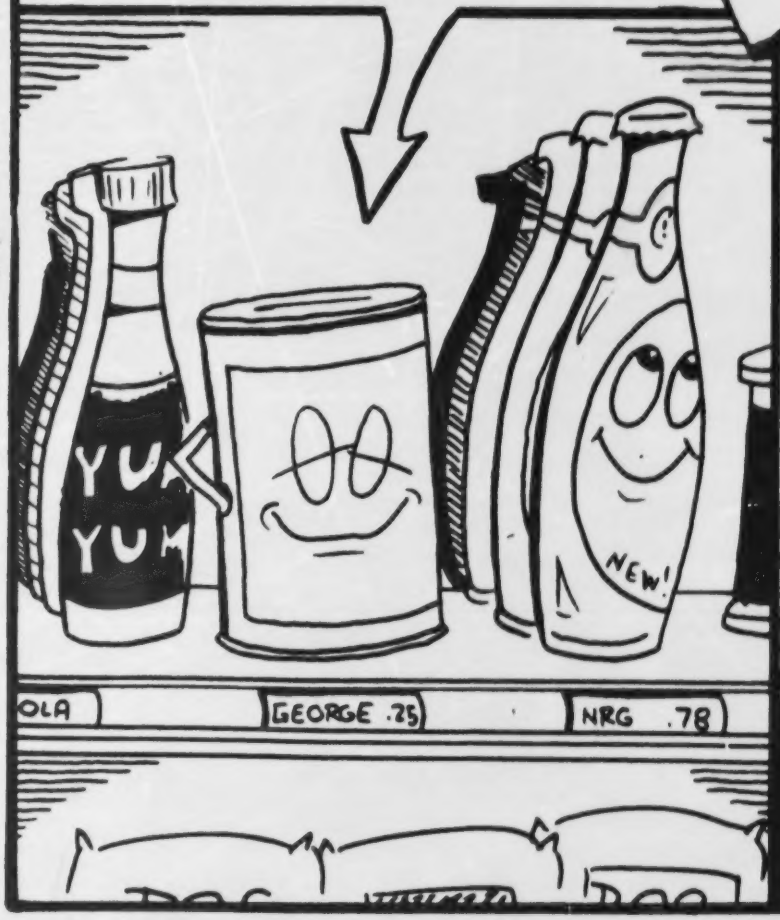
b. Math: Help students to quantify how much energy or energy products they are saving as a result of this lesson, using math functions you are currently teaching. For example, if paper is being recycled, have students count the number of sheets saved each day and add the answer to the previous day's total to get a weekly total.

c. Ask students to create another cartoon strip or puppet play using female characters. For instance, Wanda Waster and Pauline Paper might become the new characters.

**Source:** Indiana Energy Education Curriculum Project

13.5

GEORGE THE CAN WAS VERY HAPPY. HE LIVED ON A SHELF, WAITING FOR SOMEONE TO BUY HIM AND TAKE HIM HOME.




THEN *WILLIE THE WASTER* CAME OVER WITH HIS AUNT, SAYING...

SO GEORGE JOINED WILLIE'S GROCERIES- HE HAD NO CHOICE!!
GEORGE WAS OPENED AS SOON AS WILLIE LEFT THE STORE —— BUT IMAGINE HIS DISMAY WHEN WILLIE THREW HIS TOP IN THE GUTTER!!
!
WHO CARES?
GEORGE WAS NOT HAPPY!
13.7
BUT THE WORST WAS YET TO COME! WILLIE DIDN'T EVEN FINISH GEORGE'S CONTENTS BEFORE HE TOSSED HIM OUT THE CAR WINDOW!!
NOW I'LL PROBABLY NEVER GET RECYCLED AGAIN!!
WILLIE!
AH WHO CARES?
WHAT A WASTE!!
WILLIE DIDN'T SHOP TOO WISELY, THEN HE WASTED GEORGE'S JUICE AND NOW HE'S DISPOSED OF GEORGE IN THE STREET! WILLIE WASTES ENERGY!
THE END

# Student Worksheet

## ENERGY WASTER QUESTIONS

Shopper

1. Do I really need to use this product?
2. Is it best to use this product or another product?
3. _____?

User

1. When do I need to use this energy?
2. How much energy do I need to use?
3. _____?

Disposer

1. Do I need to throw this away, or can I use it again?
2. Can this be recycled?
3. _____?

# THERE'S MORE THAN ONE WAY TO CONSERVE ...

...YOU CAN DO _____ SOME THINGS...
(HIOUTTW)





**Source:** Indiana Energy Education Cirriculum Project
13.9

**Source:** Indiana Energy Education Cirriculum Project
13.10




...YOU CAN _____ _____ ON OTHERS...
(TCU KBCA)



**Student Worksheet**
Conservation Scramble

AND, YOU CAN FIND A BETTER WAY,
IN OTHER WORDS AN _____.
(LTARENTVAEI)

..THERE ARE LOTS OF WAYS TO SAVE !"



**Source:** Indiana Energy Education Cirriculum Project
13.11

**Student Worksheet**
Conservation Scramble

## ARKANSAS RECYCLER'S GUIDE

Source: Arkansas Department of Energy

### ALUMINUM RECYCLING CENTERS

**BENTON**

Alcoa
Exit 117 off I-30
Benton, AR 72015
776-0255 - Benton

Benton Salvage
Willow Street
Benton, AR 72015
847-4161 - Little Rock

**BLYTHEVILLE**

Ed Roleson, Jr., Inc.
Industrial Drive
Blytheville, AR 72315
763-7391

Goolsby Iron & Metal
West Highway 18
Blytheville, AR 72315
763-9086

Robertson Distributing Co.
615 North 2nd Street
Blytheville, AR 72315
763-3125

**CAMDEN**

Camden Wholesale, Inc.
416 Washington, N.E.
Camden, AR 71701
836-5796

**CONWAY**

Conway Scrap Metals Co.
1110 Spencer
Conway, AR 72032
329-3657

**DERMOTT**

Dermott Distributing Co.
108 North Arkansas Street
Dermott, AR 71638
538-5373

**EL DORADO**

Hepco, Inc.
630 East Faulkner
El Dorado, AR 71730
862-7986

Pesses Iron & Metal Works
423 E & B Street
El Dorado, AR 71730
863-9270

R. C. Edwards Distributing
621 South Washington
El Dorado, AR 71730
863-8621

Vincent Distributing Co., Inc.
409 East Second Street
El Dorado, AR 71730

**FAYETTEVILLE**

Coors of Western Ark., Inc.
750 South Hill Street
Fayetteville, AR 72701
442-6677

Fayetteville 7 Up Bottling Co.
335 North West Street
Fayetteville, AR 72701
442-7410

McBride Dist. Co., Inc.
Spring at West Streets
Fayetteville, AR 72701
521-2500

Recycling Center
214 North West Avenue
Fayetteville, AR 72701
442-8160

**FORT SMITH**

Belle Point Beverage, Inc.
1 Garrison Avenue
Fort Smith, AR 72901
782-3511/782-7159

**KINGSTON**

Kingston Recycling Center
Box 8
Kingston, AR 72742
665-2604
Attn: Ed Murrell

**LITTLE ROCK**

ABC Salvage & Scrap Metals Co.
Stagecoach Rd. & I-430
Little Rock, AR 72204
565-3132

Arkansas Recycle Corporation
East Capitol & McLean
Little Rock, AR 72202
372-6500

Blume Scrap Metals
1319 East 6th Street
Little Rock, AR 72202
372-5864

Coca-Cola Bottling Co. of Ark.
6901 Murray
Little Rock, AR 72209
569-2700

Coors of Central Arkansas
501 Byrd Street
Little Rock, AR 72202
372-6677

P & H Distributing Co.
1900 E. 15th Street
Little Rock, AR 72202
372-5168

Reynolds Metals Co.
University & Asher
(Village Shopping Center)
Little Rock, AR 72205
562-7763

Ruff Iron & Metal Co.
1401 Security
Little Rock, AR 72202
375-2309

Most of the scrap metal companies listed here handle other metals as well as aluminum for recycling. Please contact the firms in your area for additional details and prices.

Sol Alman Company
1300 E. 9th Street
Little Rock, AR 72202
372-5222

Twin City Beverage Co., Inc.
1515 E. 4th Street
Little Rock, AR 72202
372-0185

**MCGEHEE**

Delta Dist. Co., Inc.
420 No. First Street
McGehee, AR 71654
222-3989

**MORRILTON**

Otto Lienhart, Inc.
204 West Railroad Avenue
Morrilton, AR 72110
354-2282

**MOUNTAIN HOME**

Carlson & Marotti Dist.
1229 Commerce Drive
Mountain Home, AR 72653
425-9878

Zelk's Salvage
528 N. W. Highway 5
Mountain Home, AR 72653
425-4113

**NEWPORT**

C & C Distributors, Inc.
2nd & Plum Streets
Newport, AR 72112
523-2465

Sharp's Distributing Co.
100 Jacksonport Rd.
Newport, AR 72112
523-2062

**NORTH LITTLE ROCK**

Metal Recycling Corporation
(Industrial Specialist)
1 Riverfront Place
North Little Rock, AR 72118

**PARAGOULD**

Ed Roleson, Jr., Inc.
400 W. Baldwin Street
Paragould, AR 72450
236-6150

Samuels Hide & Metal Co.
86 East Hunt
Paragould, AR 72450
236-6944

**PINE BLUFF**

Ace Battery Shop
2300 West Second Avenue
Pine Bluff, AR 71601
535-3363

M. K. Distributors, Inc.
223 Mulberry Street
Pine Bluff, AR 71611
534-0364

Soltz Machinery Shop
310 Tennessee Street
Pine Bluff, AR 71601
353-8522

South Central Coors of Ark.
Emmett Sanders Road
Pine Bluff, AR 71611
534-7676

Southeastern Dist., Inc.
2611 East Barraque
Pine Bluff, AR 71601
536-0460

**ROGERS**

Rogers Iron & Metal Corp.
730 No. Arkansas
Rogers, AR 72756
636-2666

**RUSSELLVILLE**

Cunningham Metals, Inc.
Highway 7 South
Russellville, AR 72801
968-1574

**SPRINGDALE**

Cottrell's Scrap Metal Buyers
224 Candle
Springdale, AR 72764
751-9571

**STUTTGART**

Ludwig Dist. Co., Inc.
503 East 13th Street
Stuttgart, AR 72160
673-2161

**TEXARKANA**

Bolls Distributing Co.
700 East Broad Street
Texarkana, AR 75502
774-2795

Buchanan Distributing Co.
45 Globe Avenue
Texarkana, AR 75502
774-3715

JJS Distributing Co.
512 East Broad Street
Texarkana, AR 75502
774-4185

Tri-State Iron & Metal Co.
Hwy. 67 N. & East 14th Street
Texarkana, AR 75502
773-8409

**SEARCY**

The Thompson Co., Inc.
300 E. Mulberry
Searcy, AR 72143
268-8626

**WEST MEMPHIS**

Arkansas Distributing Co.
112 South 1st Street
West Memphis, AR 72301
735-3506

Coors of Eastern Ark., Inc.
211 North 6th Street
West Memphis, AR 72301
735-0535

McCain Distributing Co.
1 McCain Blvd.
West Memphis, AR 72301
735-0992

Mid South Iron & Metals
County Highway 520
West Memphis, AR 72301
732-6340

## PAPER RECYCLING CENTERS

**FAYETTEVILLE**

Fayetteville Waste Paper Co.
12th & Warford
Fayetteville, AR 72701
442-4722

Recycling Center
214 N.W. Avenue
Fayetteville, AR 72701
442-8160

**FORT SMITH**

Ft. Smith Waste Paper Co.
112 North East
Ft. Smith, AR 72901
783-6478

**HARRISON**

Boone Wastepaper
Industrial Park Road
Harrison, AR 72601
741-5200

**KINGSTON**

Kingston Recycling Center
Box 8
Kingston, AR 72742
665-2604
Attn: Ed Murrell

**LITTLE ROCK**

Arkansas Recycle
E. Capitol & McLean
Little Rock, AR 72202
372-6500

Goldman & Co., Inc.
1701 E. 14th
Little Rock, AR 72202
376-7101

**NORTH LITTLE ROCK**

Paper Stock Dealers, Inc.
810 W. 8th
North Little Rock, AR 72114
376-4213

**OSCEOLA**

Osceola Waste Materials
Industrial Drive
Osceola, AR 72370
563-5461

**ROGERS**

A.C.E. Recycling
P.O. Box 1224
Rogers, AR 72756
636-7391
Attn: Jim Duncan

L & L Packaging Co.
P.O. Box 1339
Rogers, AR 72756
636-5155
Attn: Roy Rogers

Individual centers offer different services to the public. Contact the recycling centers in your area to determine which one best suits your needs.

LESSON #14

**CATEGORY:** Conservation

**ENERGY TYPE:** All

**TITLE:** Carefully Consuming Carol

**GRADE LEVEL:** K-3

**INFUSE WITH SUBJECT AREA:**
Social Studies
Language Arts
Math
Art
Reading

**TIME NEEDED:** One period

**MATERIALS:**
(For Follow-Up Activity on recycling paper)
Newspaper
Water (2 cups)
Liquid detergent (few drops)
Some food coloring (optional)
Window screen or fine mesh screen
Paper towels
Iron
Blender

**OBJECTIVES:**

1. The students will understand the need for making energy conservation a priority in their everyday lives.

2. The students will apply their knowledge about energy conservation to their school, families and community.

**TASK ANALYSIS:**
The students should be able to sort pictures into categories, and must understand the meaning of alternative energy sources.

**PROCEDURE:**

1. Preparation

   Assemble materials listed above for recycling activity (optional).

2. Steps in Lesson

   Objective #1: The students will understand the need for making energy conservation a priority in their everyday lives.

   Objective #2: The students will apply their knowledge about energy conservation to their school, families and community.

   a. Talk with students about how conservation is a basic way of dealing with the energy problem. Tell them that conservation involves adjusting their way of life. Basically it can mean doing one or more of the following things: doing without some energy products we do not really need, cutting back on energy that we do need, and finding energy alternatives.

Ask students to list ways in which they might do without energy as a way of conservation, cut back on energy, or find energy alternatives.

b. Read the cartoon on Carefully Consuming Carol (pages 14.5-14.7). Carol is a consumer in the same way that Willie was a consumer in Lesson 13. The difference is that Carol is conserving where Willie was wasting. Carol is conserving in her roles as shopper, user and disposer of energy products. Have students look at the cartoon and pick out instances where Carol decided to do without, cut back, or find alternatives as she was shopping in the grocery store with her Dad.

c. Have students develop Energy Conservation Questions for shopper, user and disposer roles or use the following questions as a guide with student questions added.

Shopper
1. Can I do without this energy resource?
2. What is the amount I need to buy?
3. _____? (student questions)

User
1. Do I need to use this energy?
2. Could I use something else?
3. _____? (student questions)

Disposer
1. Can I use this energy again?
2. Can this energy be recycled?
3. _____? (student questions)

d. Discuss how the Energy Conservation Questions can be used in terms of some energy or energy products that students are currently using, such as lights, pens, paper, etc. Have them rate themselves on the questions in terms of that energy or energy product. Discuss energy conservation measures with the class and ask them how they can be better energy conservers.

e. Ask students to take their questions with them the next time they accompany their parents to the grocery store. Have them tell the class how well they did as energy conservers at the store.

f. Have students name three major ways they can conserve energy in their school. Have them practice their evidence-gathering skills by collecting information about who is conserving and how much. Let them invite school personnel in to discuss these conservation measures and to answer questions.

g. Help students make recommendations for energy conservation in their school. Be sure their recommendations are heard by relevant school decision-makers. Talk with them about how each of the recommendations is an important part of helping to ease the energy problem. Students should be able to list two or three reasons why their suggestions will make important differences in the school. (save money, save energy, improve the school environment by cleaning up litter and/or cutting down noise and harsh lighting, and improve safety factors.)

h. Collect the contents of the classroom wastebasket for a day or a week. Separate the contents into two groups--reusable and nonreusable. Ask: Can any of the contents be recycled? Are any of the items luxuries? How does throwing away reusable items waste energy? How does using products in nonreusable containers waste energy?

i. Have students make posters of things they can do for fun that require little electrical or fossil fuel energy.

3. Evaluation

a. Observation of changes in student attitudes and behavior concerning energy conservation may be used to judge effectiveness of the lesson.

b. You may test students' ability to recognize energy conservation measures by using the Word Scramble below. The scrambled words on the left may be written on the chalkboard. Then students can write the correct words on the right. (Grades 2-3)

**WORD SCRAMBLE**

How Can I Save Energy?

| | |
|---|---|
| AWKL OT LOSCHO | (WALK TO SCHOOL) |
| UNRT FOF GHSTIL | (TURN OFF LIGHTS) |
| DIERV OSLWRE | (DRIVE SLOWER) |
| LOSEC HET RODO | (CLOSE THE DOOR) |
| TRNU FFO HTE V.T. | (TURN OFF THE T.V.) |

4. Follow-Up Activities

a. Ask students to write a story or draw a cartoon about a conservation character other than Carefully Consuming Carol. Have them read their stories to the class. The characters should be a mixture of boys and girls so that students do not equate good conservation with one sex.

b. Have students list all the ways in which they think they can conserve energy products in their class or their school by doing without, cutting back, or finding energy product alternatives. Students can use math skills to count the number of items that fall into these categories. They can practice addition, subtraction, multiplication or division.

c. Make recycled paper as follows: Tear up newspaper and put into a blender. Add 2 cups water and some liquid detergent (a few drops). Add some food coloring if desired. Blend one minute. Pour into sink or pan of water. Dip square pieces of window screening or fine mesh screen into sink or pan and scoop out a layer of wet newspaper bits. Let drip and flip onto paper towels. Iron dry. Draw a picture of write a story on your new paper.

**RECYCLING CANS IS ONE WAY TO SAVE ENERGY...**

**Source:** Indiana Energy Education Cirriculum Project 14.5

BUT IT'S WORTH IT!!
DON'T FORGET MY RETURNABLE BOTTLES!
ECONO
NEW!
....BACK HOME, CAROL'S FAMILY USES WHAT SHE BOUGHT AS WISELY AS POSSIBLE....
...DON'T WANT TO WASTE ANY....
JE

14.6

...THEY EVEN DISPOSE OF THE WASTE AS CAREFULLY AS THEY CAN...
EMPTY AGAIN! GEE THAT SWEET LITTLE CAROL AND HER FAMILY MUST HAVE MOVED!!
GARBAGE
EVERYONE CAN LEARN SOMETHING FROM CAROL'S HABITS- SHE'S SAVING ENERGY FOR ALL OF US!!
THANKS CAROL!

LESSON #15

**CATEGORY:** Conservation

**ENERGY TYPE:** All

**TITLE:** Waste Uses Up Earth's Resources

**GRADE LEVEL:** K-3

**INFUSE WITH SUBJECT AREA:**
Math
Science
Language Arts

**TIME NEEDED:** Three periods

**MATERIALS:**
Modeling clay (enough for each student to have some)
Container labeled "earth"
Three small boxes

**OBJECTIVES:**

1. The students will understand that the materials they use daily come from the earth.

2. The students will discover that waste uses up earth's natural resources.

3. The students will understand that population and lifestyle affect the amount of waste produced.

**TASK ANALYSIS**
The students should be able to count up to 20 items, and should be able to make clay models of things they like to use.

**PROCEDURE:**

1. Preparation

   Read Teacher Background Information (15.5).
   See page 15.6 for a list of teaching materials and publications dealing with recycling. You may want to order some of these before beginning the unit.
   Assemble other materials listed above.

Bulletin Board Idea

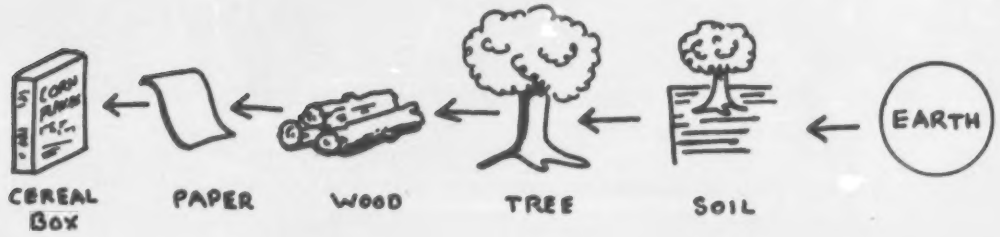
Have students bring different kinds of packages from home and display on board. A discussion of which packages are excessive and not needed could be held. The board can be divided into three categories:
1. Nature's packaging: coconuts, bananas, peanuts.
2. Older types of packaging: paper bags, pottery, returnable bottles.
3. Modern packaging: plastic wrap, styrofoam, egg cartons, plastic-coated milk containers, individually wrapped packages.

2. Steps in Lesson

   Objective #1: The students will understand that materials they use daily come from the earth.

   a. Have the students name something made out of paper, metal, glass, and a favorite type of food.

b. Using the chalkboard, help the children trace these materials back to the source. Examples: Cereal box--paper--wood--tree--soil--earth. Pop bottle--glass--sand--rock--earth. Metal can--rock--earth. Apple--tree--soil--earth.




c. Ask students if they can think of anything that they use which is not provided by the earth. (They will probably name some things but, on close examintion, it will be seen that these things are actually made from the earth's natural resources.)

Objective #2: The students will discover that waste uses up earth's natural resources.

a. Illustrate the use of a natural resource by doing the following:

From a container labeled "earth" pass out clay explaining that this is an example of taking the earth's resources to make things.

Let children make models of things they like to use.

Write the words "bury", "burn", and "dump/litter" on three small boxes. Let students place their clay product into the boxes they choose.

Ask: After we bury, burn, dump or throw away our car, paper, etc., what will happen to them?

Repeat until all the clay is gone. Point out that the resource container is now empty and that the resources have been used up; there is no more clay with which to make new things. Point out how heavy the trash can is, that someone will have to take it to the disposal site, that it will contribute to pollution, and that it will take up room at the site. Also, point out that it is still valuable material that can be used.

Ask: Can we ever get back the things we threw away? Which ones? What is going to happen if we keep taking materials from the earth? What will happen when we run out?

Suggest that instead of throwing the clay away it could be reused. If we did this with all our trash, very little would have to be hauled to a disposal site, and we would not take as much from the earth. Point out that the heat generated by burning trash could be used to run an industry, thus saving some of our precious fossil fuels.

b. Ask each student to list all the different containers that provide his or her evening meal. (Include all the materials used to make the container.) For example, a child eats soup, a hamburger, ketchup, apple sauce, carrots, ice cream and milk. The list might look like this:

Soup--metal can with label.
Hamburger--clear plastic and styrofoam wrap.
Ketchup--glass bottle, metal cap, paper label.
Apple sauce--glass jar with metal top, paper label.
Carrots--plastic or paper bag.
Ice cream--paper or cardboard container.
Milk--waxed cardboard, plastic or glass container.

Ask the students to keep a count of each material used and the total containers used. They will be interested in finding out which family threw away the most items. It should be noted that there will be a correlation between the size of the family and the number of containers thrown away. Stress accuracy--there will likely be a tendency to give elaborate totals and to magnify the amount used.

c. When estimated totals are gained for the whole class for one meal, multiply this times three to get an estimate for one day. Next multiply the class's total by the number of classes in the school.

An average count of throwaway containers per family or person should be made. Then multiply by the number of families or persons for the total number of containers thrown away in your community for one day. Then show students how it is possible to multiply by 365 to find a yearly total. Review that these containers are made of resources needed for survival.

Have students imagine that all the containers the class threw away last night were stacked up in a corner of the room. Ask: How much of the room would it occupy? How much of the room would a week's worth of trash occupy?

Objective #3: The students will understand that population and lifestyle affect the amount of waste produced.

a. Draw a square on the floor with chalk, approximately five feet by five feet. This square can also be delineated by grouping chairs to form the perimeters. Ask one child to step inside the square holding one piece of solid waste, such as scrap paper. Emphasize that each person involved cannot step outside the square once he or she is in it.

Then ask another to step in, assume they then have two children, those two marry and have two children, etc. The number will grow very quickly, yet the square remains constant.

As the square grows more crowded, obvious reactions will be observed, especially pushing, restlessness, and general aggressive behavior.

Have all students return to their seats, after having first dropped their pieces of solid waste in the square. The result they will see will be solid waste pollution. This graphically brings home the concept of more people, more waste, that our crowded cities have limited space, and that the amount of waste pollution increases every year.

3. Evaluation

a. Informal observation of students' behavior during the lesson may best show whether or not they understand that in wasting, we use up valuable materials from the earth. Notice whether or not they are conscious of their littering habits.

b. You may also use the following questions as an oral inventory:
Name some kinds of packages made by man. (plastic wrap, paper bags, cardboard containers, glass bottles, plastic bottles)
Name some packages made by nature. (banana peel, peanut shell)
From what material do we make paper and cardboard? (wood)
Name a material you use daily that comes from the earth.
What happens when people use up all earth's resources? (They cannot survive.)

4. Follow-Up Activities

a. If feasible, take a field trip to a paper mill to see how paper is made.

b. Have students figure how many pounds a day and how many tons this equals in refuse discarded if each person in the town discards 3.5 pounds each day. (Grade 3)
If it costs your community about $30 for each ton of refuse that is disposed of properly: How much does this cost per day? Per year? Where does this money come from? (Grade 3)

## TEACHER BACKGROUND INFORMATION

Source:
United States Environmental Protection Agency. Let's Recycle. United States Government Printing Office: Washington, D.C. 1980.

In the United States today we too often discard items which in earlier times would have been repaired or saved for other uses. In fact, many modern products are designed for a relatively short life followed by a speedy trip to the refuse pile.

The refuse from materials used in the United States daily adds about 140 million metric tons per year to our municipal waste (this does not include the waste generated by the industries producing these materials). This quantity of solid waste may be visualized by imagining the New Orleans Superdome being filled from floor to ceiling, twice each day, every day of the year.

How we dispose of all this waste in an environmentally sound manner is a complex and often controversial issue. Water pollution not only results from direct dumping into the seas, but also from run-off and leaching from dumps and burial sites. Air pollution not only results from open burning, but also from faulty incineration and from gases (caused by decomposition) surfacing in landfills. Fires, explosions, noxious odors, rodents, and disease must be guarded against in all cases. And direct contact with refuse is often hazardous to the public as well as to the waste collectors and processors (who, incidentally, have the highest on-the-job injury rate of any occupation in the nation).

Land disposal will continue to be the major method of solid waste disposal for the near future. It is likely that there will always be some residual portion requiring land disposal no matter how efficient our recovery, treatment, and recycling processes become.

One of the chief ways to lessen our waste disposal problems is to reuse many of the things we have habitually thrown out. If we carefully consider all purchases, we can reduce the number of items eventually thrown away and also conserve our dwindling resources.

Some of our trash has economic value. It can be sold or reprocessed to be used again to make new products. Or it can be burned to produce useful electrical and other forms of energy. This will also reduce our reliance on foreign oil supplies for fuel. Moreover, the recovery of materials reduces waste and pollution and also conserve our limited natural resources and energy.

Since it is becoming increasingly important to make the public aware of the hidden "trash crisis" which threatens to engulf our cities and our natural resource base as well, the school system becomes a valuable tool for enlightening young citizens concerning how solid waste problems relate to them, and how they can contribute to a solution.

## SOME PUBLICATIONS

Source:
United States Environmental Protection Agency. Let's Recycle. United States Government Printing Office: Washington, D.C. 1980.

**Bottle and Cans, Using Them Again.** Mcphee, Gribble, Puffin Books, 1977. (Viking Press, New York.) A colorful, well-illustrated booklet that contains many interesting activities involving the reuse of materials to make craft projects.

**Don't Waste Waste.** Environmental Action Coalition, 1976. Cirriculum for grade levels 4-6 includes bibliography and list of additional resources.

**Eco-News.** Environmental Action Coalition. A monthly environmental newsletter for young people.

**Environmental Exchange...A Beginning.** U.S. EPA, rev. ed. 1980. Office of Public Awareness. Curriculum for grades K-12.

**Garbage Reincarnation.** Sonoma County Community Recycling Center. $5.95. Instruction manual for grades K-6.

**The Importance of Being a Garbologist.** Group for Recycling in Pennsylvania, rev. ed. 1979. Intended for grades 3-6.

**Let's Dump the Dump.** Channing L. Bete Co., Greenfield, Mass., rev. ed. 1979. $.75 each, $.50 per copy in order of 25-99, plus shipping. Cartoon presentation explaining what is improper about dumps and suggesting alternatives.

**Let's Go to a Recycling Center.** G.P. Putnam's Sons, New York. 1977.

**Recycling.** An educational reprint from Ranger Rick's Nature Magazine. National Wildlife Federation, November 1971. Intended for grades 3-6.

**Recycling and the Consumer.** U.S. EPA, 1974. Office of Solid Waste order no. SW-117.1. Poster-size flyer describes what is and is not recycled, barriers to recycling, approaches to municipal recycling, trends, and what the consumer can do.

**Recyclopedia.** Houghton Mifflin Co., Boston, Mass., 1976. $3.95 paper, $7.95 hardcover. Developed at the Boston Children's Museum. Includes chapter on how to make games, science equipment, and crafts from recycled materials.

**Resource Recovery and You.** Channing L. Bete Co., Greenfield, Mass., rev. ed. 1978. $.75 each $.50 per copy in order of 25-99 copies, plus shipping. A cartoon presentation of facts about the use, reuse, reprocessing, and recycling of materials.

**There Lived a Wicked Dragon.** U.S. EPA, 1973. U.S. Government Printing Office order no. 055-002-00106-8. $1.20 each, $27.50 for packet of 100. Coloring/story book for grades K-3.

**Toys: Fun in the Making.** U.S. Dept of HEW, rev. ed. 1979. U.S. Government Printing Office order no. OHD-79-30031. Instructs children how to make toys out of common throwaway items, such as toilet paper rolls. Intended for preschool-6.

**Use It Again Sam.** U.S. EPA, 1978. Office of Solid Waste order no. SW-616. Four-page pamphlet describes operation of Federal government's office-paper recycling program. (Also available: bumper sticker, order no. SW-414; and poster)

**Waste Alert! A Citizen's Introduction to Public Participation in Waste Management.** U.S. EPA, 1979. Office of Solid Waste order number SW-800. A 32-page pamphlet giving an overview of the nation's solid waste problem and the various ways in which the public can and should become involved in finding solutions.

**Waste No, Want Not.** U.S. EPA, 1972. U.S. Government Printing Office order no. 055-002-00094-1, $.35 each, $4.50 per 100. Small poster deals with basic conservation issues from putting as little as possible into the garbage can to supporting community recycling programs.

**What You Can Do To Recycle More Paper.** U.S. EPA, 1975. Office of Solid Waste order no. SW-446. Twelve-page pamphlet discusses the recycling options of consumers, householders, citizens, students, teachers, and employees.

**A World Fit for Chipmunks and Other Living Things.** U.S. EPA Region VII, rev. ed. 1977. Coloring book or recycling litter, intended for grades K-3.

LESSON #16

**CATEGORY:** Conservation

**ENERGY TYPE:** All

**TITLE:** What Can We Do About Waste?

**GRADE LEVEL:** K-3

**INFUSE WITH SUBJECT AREA:**
Language Arts
Economics
Art

**TIME NEEDED:** Two periods

**MATERIALS:**
Two large boxes

**OBJECTIVES:**

1. The students will become familiar with the word "recycle" and use it frequently through the course of the lesson.

2. The students will begin to recycle in the classroom.

3. The students will establish a community recycling program.

4. The students will learn ways to recycle materials used in the home.

**TASK ANALYSIS:**
The students should be able to trace a path through a maze with their pencils.

**PROCEDURE:**

1. Preparation

   Duplicate Student Worksheet 16.5.
   Bring two large boxes to be used as a "use-it-again" box and as a "swap" box.
   Find out if there is a recycling program in your community.

2. Steps in Lesson

   Objective #1: The students will become familiar with the word "recycle" and use it frequently through the course of the lesson.

   a. Write the word "recycle" on the chalkboard or a large sheet of paper. Next to it draw a picture of a bicycle wheel. Point out to the students that both end in the word "cycle".

      Tell students that a bicycle wheel goes around and around. And the word "recycle" means to go around or use over and over again.

      Point out that when we recycle something, it does not add to our disposal problem but goes back around into something new. Old paper can become new paper. Old cans and glass become new cans and glass, toys, etc.

      Have the children imagine something old and what it could be turned into by recycling. Example: an old soup can may become part of a new fire engine; a newspaper may become a paper bag.

Ask: Has anyone ever heard of a "junkman" who goes around looking for people's trash?

Ask: What might there be in one person's waste that would not be trash or waste to someone else?

b. A possible homework assignment related to this concept would be to ask the students to write a short story, real or imaginary, describing something valuable that they found buried in the garbage. The stories should include accounts of the previous owners and reasons why the objects were thrown away. (Grades 2,3)

c. List all the possible advantages of recycling on the chalkboard and ask students to explain:
   Reducing pollution
   Saving natural resources
   Saving energy
   Saving money

d. Pass out Student Worksheet 16.5 and have students trace a path using their pencils from the girl to the recycling center.

Objective #2: The students will begin to recycle in the classroom.

a. Set up a "use-it-again" box for your classroom. Have students paint, color or paste pictures on it. Place in it all materials that can be used again. For example, paper that has only been used on one side can be used again for drawing paper, quiz sheets, etc. Craft items from home can also be brought in to make collages and other art projects (egg cartons, margarine tubs, thread spools, etc.)

b. Set up a "swap" box where students can bring in old toys or objects that might be thrown out. They can trade an old toy for another one that is new to them.

   Explain that long ago, before people had money, they used to exchange goods this same way and it was called "barter". Ask students why it might be difficult to get everything one needs using the barter system. (Sometimes the person who has what you want or need does not want or need what you have to trade in return.)

c. Have a show-and-tell session where students bring objects and discuss how they could be reused or recycled.

Objective #3: The students will establish a community recycling program.

a. If there is a recycling program in your community where people can bring paper, cans, bottles, or other materials, set up a recycling box for the classroom. Markets for collected materials may be found under "wastepaper", "scrap dealers", or "recycling centers" in the Yellow Pages. When you take the materials to the center bring the class to see how it is run. If you receive money for the recyclables, plan a class trip with the profits. (Be certain to check prices before expecting a large profit.)

Objective #4: The students will learn ways to recycle materials used in the home.

a. Have students draw a wall mural showing ways to recycle in the home. for example:

Use grocery bags to hold garbage instead of buying garbage bags; or take used grocery bags to the store with you when you shop so they can be reused.
Use grocery bags to wrap packages to send in the mail.
Use grocery bags for art projects.
Use small bags to carry your lunch to school.
Give things you can no longer use to people who can use them.

3. Evaluation

Ask students orally:
What does "cycle" mean? (Something that goes around or happens over and over.)
What does it mean to "recycle" paper? (To use it over again.)
Name some ways we have learned to recycle things in the classroom. (Using paper on both sides, saving crayon pieces, saving scraps and objects to use in art projects.)
Name some ways to recycle grocery bags at home. (Use them as wrapping paper, lunch sacks, garbage bags.)

4. Follow-Up Activities

a. Organize a play or a fair (or both) centered around the theme of recycling and its possibilities. If you have a fair you might include artwork related to recycling, collages made out of scraps, and inventions made entirely out of recycled materials.

This could be particularly important if your community does not recycle, for you could turn this class learning experience into an educational opportunity for the whole community.

b. If feasible, take a field trip to a paper mill or recycling center.

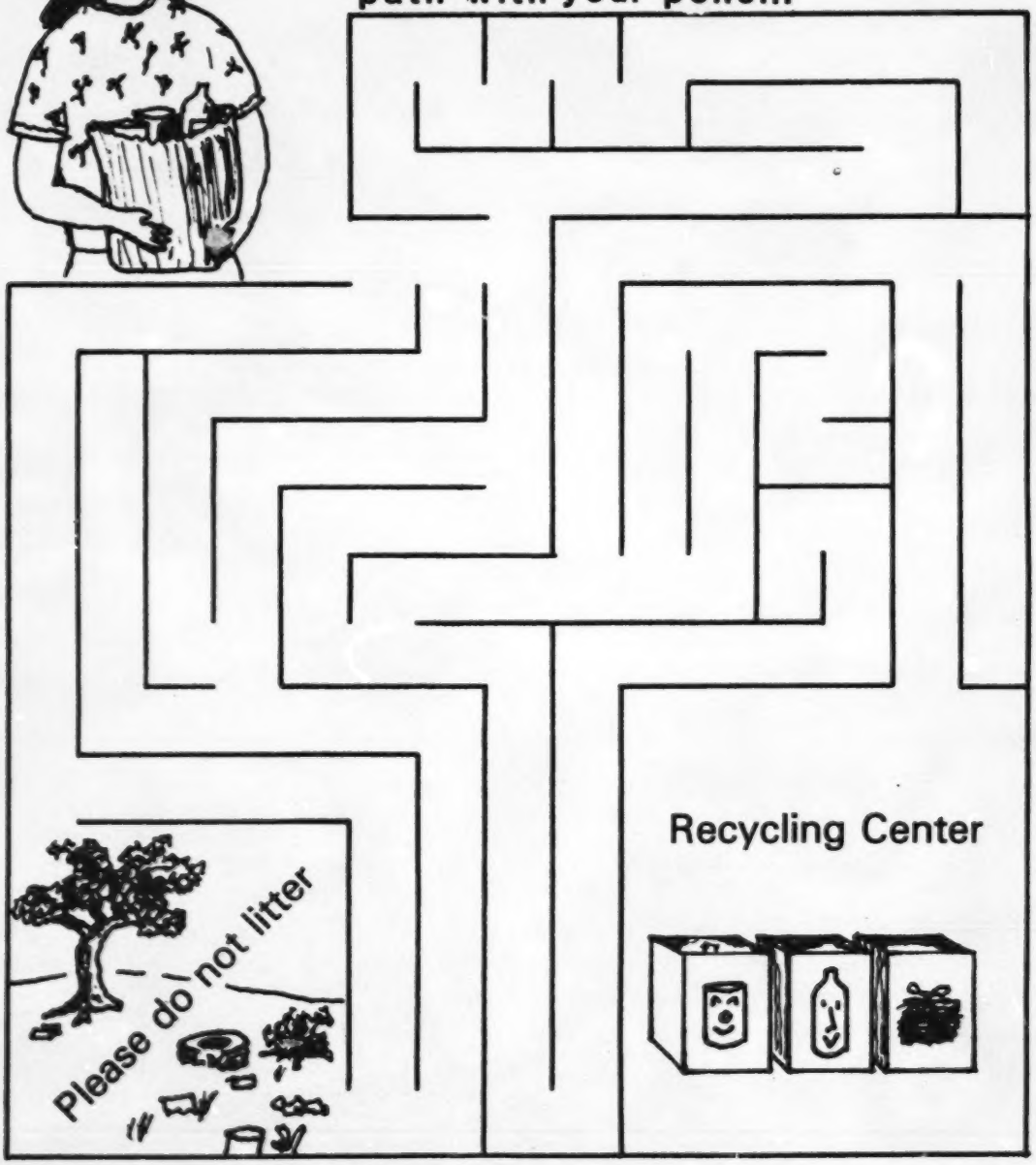
5. Selected References

Two books for children dealing with litter are available from the Arkansas Department of Education, Economic, Energy, Environmental and Conservation Education, Little Rock, Arkansas 72201. They can be copied for use in the classroom. Just ask for: Don't Be a Quitter, Pick Up Litter and Let's Twitter About Litter.

## Student Worksheet

Let's Recycle

**Direction: Help Lindsay get to the Recycling Center by drawing a path with your pencil.**




**Source:** Environmental Protection Agency

## GLOSSARY

**Active solar system:** System that needs mechanical means (pumps, fans, etc.) to harness direct solar energy.

**Alternative energy sources:** Those energy sources such as solar, wind, fission, fusion, hydrogen, hydro, biomass and geothermal which may be developed to provide energy as an alternative to fossil fuels.

**Atomic fuel:** A fuel that uses the energy of splitting atoms.

**Coal:** A fuel formed by heavy rocks pressing on dead trees for millions of years.

**Coal gas:** A fuel that is given off when coal is burned.

**Conservation:** Careful management of a resource to prevent exploitation, destruction, or neglect.

**Dam:** A wall that prevents water from flowing.

**Electricity:** Energy composed of moving electrons; for man, an intermediate form of energy which can be conveniently converted to mechanical energy or directly into heat or light.

**Energy:** The ability or capacity to do work by pushing or pulling some form of matter; energy heats, lights and moves things.

**Energy (kinetic):** The energy of movement.

**Energy (potential):** Energy that is stored and in position to be used. The energy of position.

**Energy consumer:** The role people play when using energy.

**Energy disposer:** The role played by energy consumers when disposing of energy products.

**Energy product:** Anything made from an energy source and requiring energy for its production.

**Energy user:** The role played by energy consumers when using energy products.

**Energy shopper:** The role played by energy consumers when shopping for energy products.

**Fossil fuel:** Any fuel that is formed from animal or plant remains of a previous geologic era that can be burned to release energy (examples: coal, crude oil, natural gas).

**Fuel:** Any material that can be burned or undergo nuclear fission or fusion to produce heat.

**Generator:** A machine that produces electricity.

**Geothermal energy:** Heat energy produced when subsurface rocks are heated to high temperature by energy from the decay of radioactive elements in the earth; energy extracted from the heat of the earth's interior.

**Goods:** Economic term for material things that are capable of satisfying human wants and needs.

**Grindstone:** A circular stone, used in a windmill to grind grain.

**Hydroelectric energy:** Energy created by falling or moving water.

**Kerosene:** A fuel used in jet airplanes.

**Lever:** A simple machine that makes it easier to lift things.

**Machine:** A device that makes work easier.

**Mine:** A pit in the earth from which coal is taken.

**Natural gas:** A fuel found deep in the earth or underwater; natural gas is often found with oil.

**Nonrenewable resource:** Resource that can be used up or at least depleted to such a degree that further recovery is too expensive.

**Nuclear energy:** Energy liberated by a nuclear reaction (fission or fusion) or by radioactive decay.

**Oil:** A liquid fossil fuel that is buried deep in the earth.

**Passive solar system:** System that harnesses direct solar energy without mechanical devices; usually uses the structural design of a building to collect and convert solar energy.

**Pulley:** A simple machine with a small wheel and ropes that makes it easier to lift objects.

**Radiant energy:** Energy that travels in waves; light and heat from the sun.

**Radioactivity:** Poisonous by-product of nuclear fission.

**Ramp:** A sloping floor that makes it easier to move things from one level to another; a simple machine.

**Recycle:** To reuse waste materials.

**Refine:** To change oil that comes from the ground so that it can be used as fuel.

**Renewable resource:** Resource that potentially cannot be used up; either it comes from an essentially inexhaustible source (such as solar radiation), or it can be regenerated by natural or human-devised cyclical processes if it is not used faster than it is renewed.

**Services:** Actions performed by people in order to satisfy wants and needs of other people.

**Solar energy:** The radiant energy from the sun.

**Steam engine:** An engine that gets its power from changing water to steam.

**Tanker:** A large ship used to carry oil or gas across the sea.

**Turbine:** A machine that turns a generator, which then produces electricity.

**Uranium:** An element that supplies energy for an atomic reactor.

**Utility Company:** A company that provides public services such as electric power, natural gas or telephones.

**Waste:** Items discarded.

**Waterwheel:** A wheel that is turned by moving water.

**Wind energy:** Mechanical energy of moving air.

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Social Studies School Service. Everyday Conservation: Energy and Resources. Social Studies School Service: Culver City, California. 1979. Order from Social Studies School Service, 10,000 Culver Boulevard, P.O. Box 802, Department E, Culver City, California 90230. #INS 762/$5.95 plus postage. (Eight color posters and 16 task cards. Topics include taking care of personal belongings, not wasting food, conserving water and electricity, recycling and oil conservation.)

Topeka Outdoor Environmental Education Center. Energy and You. Topeka Environmental Education Center: Topeka. 1979. Available from Topeka Environmental Education Center, 1601 Van Buren, Topeka, Kansas 66612. Price/$2.50.

United States Department of Energy--Technical Information Center. Oil. United States Department of Energy: Oak Ridge, Tennessee. 1977. Order from United States Department of Energy, P.O. Box 62, Oak Ridge, Tennessee 37830. Price/free.

Films available from the Arkansas State Department of Education
on the primary level.

**FOOD FROM THE SUN (1591)**
Uses demonstrations and animated drawings to show how all life on earth is reliant on the sun for energy. Explains the process of photosynthesis. From the Basic Life Science--What Are Living Things Series.

**HOW SUNSHINES HELPS US (1476)**
Shows that sunshine gives us warmth and light, helps make rain which supplies water to plants and animals and enables green plants to grow.

**MATTER, MATTER EVERYWHERE--HOW MATERIALS CHANGE (1662)**

**THE SUN (1698)**
What the sun is and what its role is in animal and plant life, light and heat energy. From The Science Series.

## EVALUATION OF STUDYING ARKANSAS' VALUABLE ENERGY

Circle Unit Level K-3 4-6 7-12

Type of Class (math, science, social studies, etc.)_____

Grade Level_____Teacher's Name (Optional)_____

School_____City_____

1. **CONTENT:** Did the students gain appreciably in energy knowledge and understanding?____yes____no. Describe_____

2. **WORKSHEETS:** Were the student worksheets appropriate to the interests and abilities of your students?____yes____no. Describe_____

3. **ATTITUDE:** Did the students' attitudes improve toward the importance of energy conservation?____yes____no. Describe_____

4. **TEACHER BACKGROUND INFORMATION:** Was it adequate?_____Inadequate?____

   Describe_____

5. Energy topics which you would like to see included in future revisions.

6. Other comments (use back of page if needed)_____

Return to: Helen Holmes, Coordinator of Economic, Energy, Environmental and Conservation Education; Arkansas Department of Education; Arch Ford Building, Room 404-B; Little Rock, AR 72201